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ENGINEERING NEWS.

THE DEEP WATER HARBOR CONVENTION which met at Topeka, Kan., Oct. 1, was attended by over 1,000 delegates. Congressman MANSUR, of Missouri, was made temporary chairman, and explained the commercial advantages that would accrue to the principal cities of the West if a deep water harbor were established on the Gulf coast. He warned the Texas delegates that they must not bring their disputes over the location of the harbor into the convention. Some of the delegates favor the establishment of three harbors on the Texas coast, which will compete with each other as shipping ports.

At the second day's session Senator PLUMB of Kansas was elected chairman of the permanent organization. He made a strong speech pledging the aid of Kansas to the deep harbor movement. He favored the three-harbor plan; and said that the supervision of the work should be by civilians rather than by the engineer officers of the United States Army.

VALPARAISO is to have a dry dock involving an outlay of $4,000,000. Negotiations are proceeding with a French company for building additional lighthouses in which the electric light will be used. The cost of the lighthouses is estimated at $3,500,600.

THE SUEZ CANAL REVENUES amounted in June to $1,095,000, as compared with $988,000 in June, 1888. The aggregate transit revenue collected in the first half of this year amounted to $7,080,000, as compared with $6,700,000 in the corresponding period of 1888.

A SUBMARINE BRIDGE is proposed between Elsinore and Helsingborg, to be encased in a double tube, having the outer skin iron and the inner one steel, the space between the shells to be filled with concrete. It is proposed to submerge the bridge sufficiently deep to allow ships to pass over it.

TEN NEW STEEL CRUISERS will be recommended by Secretary TRACY in his forthcoming report. Instead of leaving a Congressional committee to settle upon the tonnage, horse power, and general scheme of these boats, as has been the past practice, it is now proposed to give more power to the navy department. A better and more efficient class of vessels is expected as the result of this new departure.

A NEW OCEAN CABLE LINE is being discussed in Madrid. A line laid between the Canary Islands and Porto Rico will connect Spain with Cuba.

THE GRADE CROSSING QUESTION is being studied by the Boston & Albany Railroad Company through the medium of a carefully made topographical map of the entire line and its immediate surroundings.

THE CONNECTICUT GRADE CROSSING LAWS are being complained of as inoperative. Since the law went into effect not a railway company in the State has taken steps towards securing orders from the Railroad Commissioners for the removal of crossings, and only two towns have so far appeared as petitioners for abolishing grade crossings. The fatality statistics on the Consolidated Road alone, for the nine months ending June 30, 1889, show only 4 passengers killed by the road and 21 employés killed, 3 of the latter by coupling trains and 9 by falling from trains. The total number of employés injured was 177; 86 while coupling and 21 by falling from trains. Of trespassers on the track 68 were killed and 44 injured. The number of persons killed on the track who were not trespassing was 15 and the injured 16. This report shows that an unusual vigilance is being exercised as regards passengers, but that the general loss of life, as compared with previous years, has increased.

THE BLAME FOR THE QUEBEC ROCK SLIDE is laid on the Dominion Government. The verdict of the coroner's jury declares that the deaths of the several victims were "due to the gross and culpable negligence of the Federal authorities of the Dominion of Canada in not taking the necessary and timely precautions, by not building the buttresses recommended to the said authorities by the City of Quebec Engineer in his report of the year 1880."

A dispatch from Quebec to the Toronto *Globe* alludes to the precautions which were taken by the Federal Government in the following words. "Nine years ago, and repeatedly since, the Ottawa Government was warned of the danger. Their engineers came and inspected the rocks, and to uphold 10,000,000 tons of stone, as has been proved at the coroner's inquest, they placed two bolts and a half-inch chain, threw twenty-five barrels of clay into a crevice, and built at the foot of the cliff a two-foot wall, which broke like glass under the falling mass."

SINCE THE ABOVE WAS WRITTEN we have received a communication from an authoritative source giving facts which put a somewhat different face on the matter and indicate that the above hasty verdict of the coroner's jury did injustice to those in charge of the Dominion Department of Public Works. According to this statement, the report of City Engineers BAILLARGE of Quebec, made to the Minister of Public Works in 1880, called attention to the dangerous condition of the roads, and advised that certain property on Champlain Street should be purchased, the houses pulled down and the street widened, that a low retaining wall should be built, and that the crevices which had appeared should be filled with concrete. He further advised that if, after these precautions were taken, it should be found that buttresses were needed, they should be built. This suggestion was acted on to the letter and $37,000 was spent in 1881 and 1882 on these works. The buttresses, however, were never built, and it does not appear that Mr. BAILLARGE made any second report as to their necessity after the other precautions were taken. Our correspondent does not inform us, however, whether the Government made any inspection through its own engineers, and it seems very strange that this should not have been done; since, although no such great slide was apprehended, it was known that crevices were appearing which theatened the stability of the famous Dufferin terrace.

THERE is probably not a place on the continent where the circumstances would make possible another such disaster as that at Quebec; but there are plenty of railway cuttings where masses of rock or gravel great enough to wreck a railway train are ready to slide down when a heavy and long-continued rain shall loosen them from their bed. Steep slopes may be a necessity in the original construction; but they should be closely watched and made absolutely safe as soon as the financial condition of the company will permit.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a rear collision about midnight on Sept. 27, between two sections of an express train on the New York Central & Hudson River Railroad near Palatine Bridge, N. Y. The trains were sections of the St. Louis & Chicago express, and the second section should have been ten minutes behind the first. At night offices along the road illuminated figures are displayed, showing the exact time at which the last train has passed, so as to guide the running of following trains. An accident happened to the engine of the first section, but the engineer continued, losing time. Finally the train had to be stopped. Whether the rear brakeman went back, as he should have done, is disputed. The engineer of the second section saw no signal, however, and when he saw the tail light of the first section there was not time to stop. It is said that the second section was following too closely upon the first. Two of the cars were telescoped and several others badly wrecked; the second engine was also wrecked. There were five persons killed and five or six injured. We comment on this accident elsewhere. — A collision occurred Sept. 25 on the Philadelphia, Wilmington & Baltimore Railroad, near Claymont, Del., between a work train and a wildcat engine; 12 men were injured.

COL. W. A. ROEBLING expresses the opinion that an overhead track cannot be placed on the Brooklyn Bridge for the reasons, first, that the present cables could not carry the load without giving up the promenade, and secondly, that it would be impracticable to strengthen the cables, because they are already strong enough to pull up the anchorages before breaking. It would, however, be easily possible to greatly increase the resistance of the anchorages by filling in the arched spaces in it with masonry or with the waste lining of puddling furnaces, which contains some 60 per cent. or more of iron and can be obtained in cubical blocks for a couple of dollars a ton.

THE MERCHANTS' BRIDGE, at St. Louis, is progressing as follows, according to the *Globe Democrat:* Caisson No. 4 is being sunk, its cutting-edge being now 41 ft. below high water. The first consignment of steel girders has been delivered from Athens, Pa., and Buffalo, N. Y., from the works of the Union Bridge Co. Contracts for the elevated approaches have not yet been let, but the bridge superstructure will probably be completed by June 1, 1890, ahead of the contract time.

ST. LOUIS' CLAIM FOR THE WORLD'S FAIR is enforced by drawing a circle of 500 miles radius with New York, Chicago, and St. Louis respectively, and then determining by able statisticians, who can evolve from their inner consciousness the growth of the past 9 years since the last census was taken, that New York's circle includes a population of 34,000,000, Chicago's, 27,000,000, and St. Louis', over 30,000,000, Now York and Chicago standing low because of the large proportion of water included in the area. But the population on the spot is a more potent factor than the population within 500 miles, although both factors have weight.

THE ST. LOUIS, MO., WATER-WORKS are being extended at a cost of $3,000,000, or more, to obtain a new and increased supply. The new supply will be from the Mississippi at Chain of Rocks, about 7 miles above the present pumping works at Bissell's Point. Water will be taken from the river through an inlet shaft and tunnel, the former to be surmounted by a tower. The shaft now being sunk is about 8 ft. sq. and will be 84 ft. deep, 50 ft. being through solid rock. From near the bottom of the shaft a tunnel will extend beneath the river for 1,600 ft. and then 600 ft. further, towards the hills. The tunnel will at all points be at least 20 ft. below the river bottom. It will be 7 ft. in diameter and have a daily capacity of 100,000,000 galls. at the shore end of the tunnel. Pumps will lift the water

to settling basins, from the last of which a conduit about 7 miles long will extend to the present settling basins at Bissell's Point, from which it will be distributed throughout the city.

FOR THE FIRST 3½ MILES the above tunnel has a daily capacity of 110,000,000 galls. The remaining 4 miles will have a daily capacity of 60,000,000 galls. The fall of the conduit is but 3.7 ft. from the Chain of Rocks to Bissell's Point, or about 1 ft. in 10,000. The greater capacity of the first section of the tunnel is a provision for securing an increased in the future.

The bottom of the conduit will be of concrete, the side walls and arched top of brick, with a concrete back and top-filling.

The work is in charge of Water Commissioner M. L. HOLMAN, who is really Chief Engineer of the water-works. S. B. RUSSELL is Principal Assistant Engineer. S. F. BURNET has charge of the tunneling at Chain of Rocks; THOMAS B. MCMATH, of the conduit; JAS. SELDON of the settling basins.

THE GREAT BIG BEND GOLD-MINING PROJECT has come to grief. Californians now say that they never had much faith in the scheme. The proposition was to tunnel two miles through a mountain and through it drain 14 miles of the bed of the Feather River. The projector asserted that the company could clean up millions in gold dust which had lodged at Big Bend. Placer miners in the early days took fortunes out of the river a little further up, and samples of sand from the river bed were very rich. Dr. PIERCE, of Buffalo and of the "Pleasant Purgative Pellets," etc., was interested, and work was begun. Four years were spent in boring a tunnel through rock for 12,000 ft.

When finished, it proved too small and was enlarged from 9 x 16 to 12 x 16 ft. Then, about a year ago, the water was turned into the tunnel and the river bed drained; but a fortune was not found, as it proved very expensive to get gold from under the big boulders in the river bed.

Dr. PIERCE, who had sunk over a million in the enterprise, has now become disgusted, and the whole undertaking, which has cost about two millions, will be dropped. It is reported that a large number of newspaper men in New York have lost heavily in the enterprise. Possibly some knowing Californians may now step in and reap what the tenderfoot has sown.

THE ST. CLAIR TUNNEL stockholders held their annual meeting on Sept. 27. A new Board of Directors was elected, and Mr. JOSEPH HICKSON, of Montreal, chosen President, Mr. L. J. SEARGEANT, Vice-President, and Mr. ROBERT WRIGHT Secretary and Treasurer.

A TUNNEL NEAR THE SPLUGEN PASS, between Switzerland and Lombardy, is talked of. The length of the tunnel would be 11 miles, and it would occur on a line of 61 miles running from Coire to Chiavanna. The estimated cost for a double-track tunnel is about $33,000,000. It would appear that the gain from such a tunnel will not at present warrant the outlay required.

EIFFEL TOWER SHARES of the par value of 500 francs were quoted last week at 665 francs each. The company has already paid back to each shareholder four-fifths of the par value of these shares. It evidently pays to lift the crowd above its everyday, humdrum level.

ONE OF THE HIGHEST MASONRY STRUCTURES in the world is the new National Museum in Turin, Italy. Originally designed for a synagogue, it was sold to the city and converted into a museum and monument to VICTOR EMMANUEL. The statue surmounting the spire is 538 ft. above the ground.

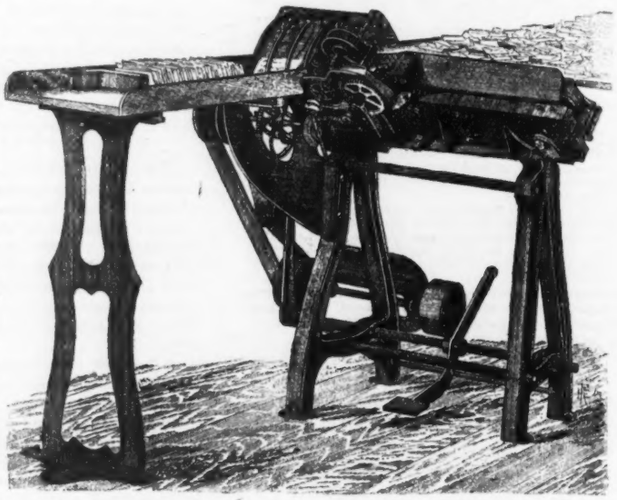
STIMULATED by the recent resolution at the Milwaukee National Encampment of the Grand Army of the Republic, requesting his widow to consent to the removal of Gen. GRANT'S remains to Washington, the local Grand Army men seem to have resolved that such a disgrace and reproach to New York shall not occur, and propose to raise the money for a proper tomb in New York State. The monument fund is now $130,000, which it is proposed to increase to $1,000,000, completing the tomb by 1892.

The Ethridge Postmarking and Stamp Cancelling Machine.

The important machine for doing away with the slow and very objectionable hand stamping of letters and for facilitating the mails, which is illustrated this week, has been in constant operation in the Boston post-office for nearly five years, the first machine of the kind in the world having been put in operation there, Nov. 29, 1884. The Boston office now has ten of these machines in constant use, but for some unknown reason these machines have not yet been employed in any other post-office in the country.

A brief sketch of how this machine came to exist, the difficulties which had to be met in attaining the apparently simple result of dating and cancelling the stamp on a letter, as well as some account of what it does, may not be without interest. It is safe to say that not one in a thousand of those receiving letters from the Boston office, in all parts of the country and globe, having the peculiar barred stamp cancellation and withal legible postmark, shown in Fig. 3, has had any idea of how this has been done or has probably ever given a thought from curiosity about the matter.

Previous to 1884 considerable endeavor had been made by various inventors to do away with hand stamping. The process was slow, the stamps lamed the arms of operators and produced painful sores on the palm of the hand, the speed was comparatively slow, and the result nearly always illegible. Inventors saw the promise of a rich reward from the use by the Government of a machine to do this work, could these defects be removed. Accordingly machines were made, on various principles, that cancelled the stamp by corrosive acids or by puncturing it with a gridiron of fine holes. It is said an important check was destroyed by one of these machines cancelling the signature while in transit through the mails. At any rate, none of the results were satisfactory.



Postmarking and Cancelling Machine, Boston Post-Office.

In the summer of 1883 Mr. F. E. GALLOUPE, M. E., was engaged with the inventor, Mr. M. V. B. ETHRIDGE, of Boston, in designing a machine to meet the rather complex requirements of the mail service and avoid the objections which had previously been fatal to the success of the idea.

The first requirement was that of speed, and it was decided that the machine should be operated by power, leaving the operator to do as little as possible of what could be done automatically. For this purpose a rotary motion was adopted, instead of a reciprocating motion, as in ordinary stamping, and the idea was conceived of feeding the letters into a small iron V-shaped hopper or trough in an inclined position, over the lowest side of which runs an endless belt, provided with a ledge at the bottom edge for catching the letters and transporting them to the stamping rolls.

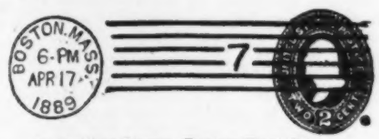
The die of the stamp was inserted in one of a pair of small iron rolls, 4 ins. in diameter and of a width somewhat greater than the postmark circle.

The under roll serves as the block on which the stamping is done and carries the feeding belt at one end of the trough. At the other end of the trough, which is 18 ins. long, is an idle pulley for the other extremity of the belt loop. So far, all was plain. But from this point perplexing difficulties arose. The stamping roll, which contained removable steel type for the changing of the time and date, could be easily inked by a small inking roller revolving in contact with it, but this would cause the feeding belt to become inked over whenever the stamp rolled against it and no letter happened to be under it. Again, letters vary in size from 3 to 8 ins. in width and from 4 to 12 ins. in length. The machine had to be so designed that this range of sizes could be stamped, coming in any order and moreover, to stamp a letter with equal pressure, although the letter should be of any thickness, from that of tissue paper to half an inch in thickness.

To accomplish all this, the machine is so made that the stamping roll constantly revolves, being connected by small gears with the belt shaft, but never presses against the belt roll unless a letter is beneath it in proper position to be stamped. To accomplish this, the stamping roll carrying the inking apparatus is carried on an arm which may be rotated about the belt roll shaft and is kept in such a position that the stamp roll rotates, when no letters are being fed, about ⅛ of an inch above the belt. A little device, called the "intelligence" of the machine, acts to bring the stamp roll down to the belt roll whenever a letter is brought under it, and this is so sensitive that a piece of tissue paper on the feeding belt is sufficient to operate the device, which only weighs two or three ounces. The action is produced by the advancing edge of the letter or postal card, which depresses one arm of a light tilting lever which lies between the belts, for two narrow belts are used for the letter feed. The other arm of this lever carries a thin steel block on the end of a piece of flat spring, which is thus swung out from its position under the stamping roll, to allow the roll to drop. A spiral spring lifts the roll away, and a small cam, which acts intermittently at a certain point in every revolution of the stamping roll, brings the roll down upon the block when there is no letter, and upon the letter when the block has been removed by its advancing edge. Two feet, or "kickers" are pivotted to the stamp roll, and so held by a spring that at the exact position in each revolution at which the edge of the letter is required to be, to bring the stamp in proper position upon the letter, these feet strike the letter and hold it firmly to the belt, so that it cannot slip during the feeding between the rolls. These kickers or clamps clear the inking roll and do not act unless the roll is brought down, which only occurs when a letter is in a certain position on the feed belts. This is accomplished by a stop just above the feed belts, which keeps advancing letters back until the stamp roll reaches the proper position, when this stop lifts, and the clamps come down to feed the letter, with a positive motion, to the stamping point.

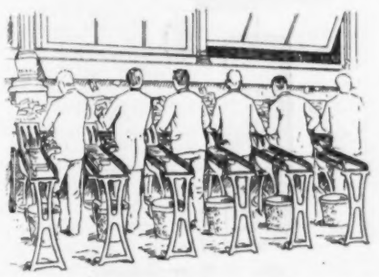
To use the machine, the feed belt of which is continuously driven by a power belt from a counter shaft, it is only necessary to face the letters into the trough, one at a time. The machine does all the work of feeding, stamping, and delivering the letters in bunches of a thousand or more, all properly faced and ready for sorting. The letters, as they are dropped through the receiving slots in the post-office, fall upon a long table or shelf just in front of the troughs of the machines (Fig. 1), and are of course in confused heaps. The operator has to face these just as he formerly had to do in preparation for hand stamping, that is, the addresses must be

turned towards the operator, and the letters are then dropped one by one, upside down, so that the stamp corner is the lower advancing end of the letter, upon the feeding belt.



Cancelling Stamp, Boston Post-Office.

To deliver the letters from the roll, after stamping, no device is necessary, as it was found that the momentum acquired in passing through the rolls carried them forward a sufficient distance for clearance and so that they could be acted upon by the packers. The packers are four in number, and consist of very peculiar-shaped cones or spirals, whose exact shape was only determined after repeated trials with letters of varying width. The letters fall upon an inclined table and inside the packers, which revolve continuously, and push them out with a screwlike motion one by one upon the sorting table of the machine. The entire machine, as now made, is about the size of a common sewing-machine, and all the mechanism is compressed in a space of somewhat less than a



Part of Cancelling Department, Boston Post-Office.

cubic foot. The machines are speeded to run a little faster than the fastest operator can feed, and the machine takes no time, as was necessary in hand stamping, for the work is done as rapidly as the letters can be picked up and forced into the hopper.

From 100 to 150 letters are marked per minute with perfectly legible work, and the stamps cancelled, the speed of the machine being limited only by the feeding power of the operator. Each machine does a work equal to four of the quickest men in the department by hand stamping. The Post Office Department rents the machines at a yearly rental of $250 each, including care, repairs, and renewal, and they are now considered indispensable. A requisition has been made, we understand, for 250 more for immediate use in some of the larger offices of the country, and it is estimated that 3,000 of these machines will be required for the post-offices of this country alone. All the hand-stamping tables except one are in disuse. One hand stamper is employed in cancelling and marking letters of unusual size and weight, which cannot pass through the machine constructed for the ordinary sizes of letters. An idea of the immense aggregate waste of muscular force can be gained by watching this solitary individual bunching and punching diligently, and only succeeding in making unintelligible blurs, that look as much like Kalamazoo as Boston.

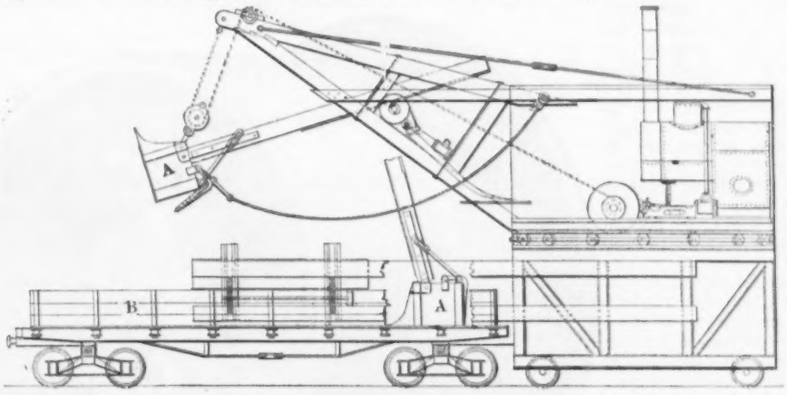
The Boston post-office is the distributing center for at least 600,000 people. A word as to the business done here, in connection with these machines, may be added. The gross receipts for the year ending June 30, 1889, were $1,865,447, a gain of $135,069 over the previous year. The expenditures were $754,056, leaving a net revenue of $1,111,391. The whole number of clerks employed is 417; an increase of 34 clerks has been made during the year. The total number of pieces of mail handled in the city delivery division was 186,091,791. The number of pieces despatched in the mailing division during the year was 378,179,448. The registry division handled 1,522,821 pieces. The money order division pays out about $3,000,000 per year.

For second-class matter, principally newspapers mailed by publishers, etc., the stamps used amounted to $101,401 for the year, representing 10,140,173 lbs. of second-class matter mailed, or 5,070 tons in the course of a year.

A Steam Shovel for Unloading Cars.

The accompanying illustration gives a side view of a machine for handling coal, coke, gravel, broken stone, limestone, or similar material, recently placed on the market. In operation the scoop *A* is lowered to a position on the car as shown, and is loaded by a forward and upward movement. It may then be swung around, and brought toward or away from the center to bring it over the desired point, and the load may then be dumped.

The machine is mounted on an iron frame running upon a track of about 15 ft. gauge, which may be set at such a height that loaded cars can pass directly under it. A winding drum enables the operator to move loaded cars on the tracks beneath without the assistance of a locomotive. It is claimed that locomotives can be coaled cheaply and rapidly by the machine, and that wherever there is an amount of work to be done sufficient to keep the machine busy, it will unload cars at one-fourth the cost of hand labor.



Steam Shovel for Unloading Cars, Vulcan Iron Works.

The machine can also be used for handling ore buckets by detaching the scoop and attaching a chain; and it will swing them from the place of loading to the dump as fast as any machine built especially for the work.

The capacity of these machines handling coal or ore is said to be as much as 1,000 tons per day. The scoop does not injure the floors of cars or boats.

The machine was designed by Mr. H. T. STOCK, proprietor of the Vulcan Iron Works at Toledo, Ohio, well known as builders of contractors' machinery. Mr. STOCK now builds for contractors four sizes and styles of dredges, four sizes of railway excavators, and three sizes of pile drivers, besides the car unloader above described.

India-China Railways.

In the article on "Railways in China" published in our issue of Sept. 21, reference was made to a project for a line from Peking to Yunnan in the southwest. In this connection the following note from the London *Financial News* is of interest:

The India Government is at last taking active steps to test the feasibility of constructing a railway through the Shan States towards southwestern China. A deputation of two engineers will survey the country in the next cold season, and will thus put to the test the evidence in favor of the project adduced repeatedly by Mr. ARCHIBALD COLQUHOUN and Mr. HOLT S. HALLETT. This resolution of the Government is the more welcome because it is transmitted to this country concurrently with a report on the trade of Bhamo, which is said to show clearly that "the chief obstacles to trade with China" are the insecurity on the borders of Burmah "and the heavy dues in China." That is the species of statement which has been potent to delay any attempt to put the schemes of Messrs. Colquhoun and Hallett into practice, and it is satisfactory to find that official prejudice is giving way. A railway should do much to reduce insecurity on the frontiers, and to open the eyes of the Yunnanese to the benefits of freer trade.

How State Railways Pay.

Victoria is an Australian colony with the size and the population of Kansas in 1880, or an area of 87,000 sq. miles, and a population of 1,000,000.

But instead of letting corporations build the railroads and giving land away to get them to do this, Victoria has kept its land and built its own railroads. The result is that this thriving little community of about 1,000,000 souls, or the population of Philadelphia, had last year an income of $41,000,000, and of this sum $16,500,000 was in the shape of profits on the State railroads. Seven years ago the income from the railroads was only $9,000,000; in 1886-7 it was $12,365,000; and for the year just closed it has gone up to nearly double the income of seven years ago, and as no one can build roads but the State, and the State is an enterprising builder and a good manager, the profits on the railroads will in time pay all the expenses of the Government. In addition, Victoria owns not only the post-office, as the people do here, but all the express business and all the telegraph business, and the profit on these for this wise, thrifty little State last year was $2,140,000.

Victoria has a heavy debt of $165,595,000, but as all but $5,500,000 was incurred for railroads and water-works, which pay a heavy profit, taxpayers feel tolerably happy over it, and the remaining fraction went into school buildings, which pay a profit in their way, too. As all the horse-car lines are owned by the people also, the cities in Victoria get more and more profit from them the bigger they get, and the taxpayer again finds that it pays to own these means of communication, even if he has to run in debt for them.

The natural result is that the surplus last year was $4,400,000, the revenue outrunning estimates by this amount. In the year just coming it will be bigger, and the "budget speech" of the Minister of Finance was principally taken up with telling the direct and indirect taxes which could be repealed.—*Philadelphia Press.*

Cost of Electric Lighting.

The following condensed statement shows the prices paid for all-night lighting by 2,000 c. p. lights in the following named cities:

	No. lights	Price per light
Albany, N. Y.	481	$182.5
Rochester, N. Y.	252	104.5
Kansas City, Mo.	60	200.00
Salem, Mass.	160	164.25
Hoboken, N. J.	10	146.00
Manchester, N. H.	235	156.95
Fargo, Dak.	25	340.00
Newark, N. J.	81	146.00
Dayton, O.	122	150.00
Akron, O.	171	157.48
Kalamazoo, Mich.	128	182.50
Springfield, Ill.	100	137.50
Boston, Mass.	700	237.50
Des Moines, Ia.	88	141.00
Texarkana, Ark.	18	160.00
Grand Rapids, Mich.	110	140.00
Washington, D. C.	350	182.50
Camden, N. J.	85	146.00
Plymouth, Pa.	12	146.00
Duluth, Minn.	180	127.00
Scranton, Pa.	322	73.00
Binghampton, N. Y.	100	140.90
Syracuse, N. Y.	300	144.00
Fall River, Mass.	50	180.00
Philadelphia, Pa.	33	200.75
Aspen, Col.	16	216.00
Montgomery, Ala.	100	155.18
East Saginaw, Mich.	136	140.00
Average		$160.54

The statement shows a tolerably wide range from $73 to $340, and indicates that electric lighting can be done much cheaper than it is done in most cities.

A New Telemeter System.

The telemeter devices illustrated herewith are for the purpose of transmitting electricity to distant points, and recording hydraulic or steam pressure, height of water in tanks, reservoirs, or dams, and the temperature in mines, kilns, and feed water in pipes.

The instruments for this purpose are all of similar construction, the only difference being that of adapting the primary instrument (steam gauge or thermometer) to the electrical mechanism. A description of one will apply equally to all of the others.

The telemanometer, or electrically recording steam gauge, will probably furnish the best example for this purpose. The steam gauge is placed near the boilers, because if carried any great distance through pipes, a certain percentage of the pressure is lost. The steam gauge is an indispensable adjunct to all steam boilers; but the ordinary one leaves no trace of what the pressure has been, only showing the pressure at the point where it is located. The engineer or fireman goes to the steam gauge, and notes the pressure at the time he looks at it. It may have been much higher or lower just before, or it may be slowly rising or falling: there is nothing to show this except by closely watching the index hand. This takes time. The telemanometer, Fig. 3, is designed to furnish a better method than this, and to preserve a record for future reference. For this purpose two or more instruments are used. The transmitter, which consists of an ordinary steam-gauge spring, to which the electrical mechanism is attached, is connected to the boiler in the usual way. The steam gauge spring is not hampered in any way, and the index hand is free to move in either direction, making electrical contacts at the proper time. The receivers (of which there may be one or more as desired) can be placed at any distant point from the boiler. Thus, one can be placed in the office, a long distance away, another in the engine room, and others wherever it is desired to have them. All will act in unison.

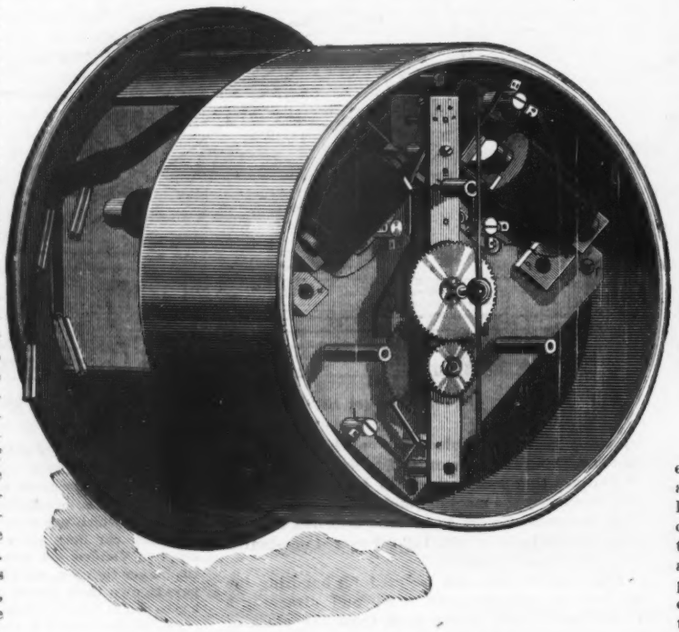


Fig. 1. Telethermometer Transmitter.

The instruments are connected by wires, and operated by open-circuit batteries, located at any convenient point. The receivers can all be self-recording and indicating, or one can be recording and indicating, and the rest indicating only. The fireman reads the indication of the transmitter at the boiler, as he reads the ordinary steam gauge. The engineer can do the same in the engine room, and also see the record of what the pressure has been; the managers in the office can look up from their duties, and see what pressure there is on their boilers, or they can, after an absence of hours or weeks, see how closely the pressure has been kept to the standard, and when it has been at the different points. In addition to this, the receivers are provided, on their indicating dials, with adjustable contact hands, which can be set at any desired maximum or minimum pressure, so that when either point is reached, an alarm bell will ring, and call the attention of the men in charge. This alarm bell is placed usually on the receiver, but can be placed wherever desired, the same as any electric bell. The record is clearly traced in ink upon distinct, open-scale, printed time charts, daily or weekly.

Our illustrations show a few of the many applications to which the system has been applied, and which are now in practical operation. The instruments, after being placed in position, do not require any extra attention.

In Fig. 1 is shown a telethermometer transmitter with the indicating dial removed. The complete electrical mechanism is here shown with the connecting wires. The thermometer pressure gauge, or other primary instrument whose indication it is desired to transmit and record, is placed back of the electrical mechanism, in such relation to the latter that the movement of its hand will make a contact with the circuit-controlling devices. Fig. 2 represents a recording receiver, with the indicating dial removed. Fig. 3 represents the telemanometer previously described, Fig. 4, one of the applications as a height of water indicator. This is of special value where the rise and fall of rivers is of commercial importance, as also for water-works reservoirs. The possibility of showing the river level at numerous points in the vicinity, from one standpipe, will be appreciated by all interested in river traffic. The instrument is also of value as a tide gauge. This has been adapted also to closed tanks under pressure, in which water, oil, or other liquids are confined, and whose depth it is desired to know. The same instrument is readily adapted to have the bell or drum of a gas-holder, takes the place of a float, thus giving an indication and record in the office from which the cubical contents of the holder can at any time be determined.

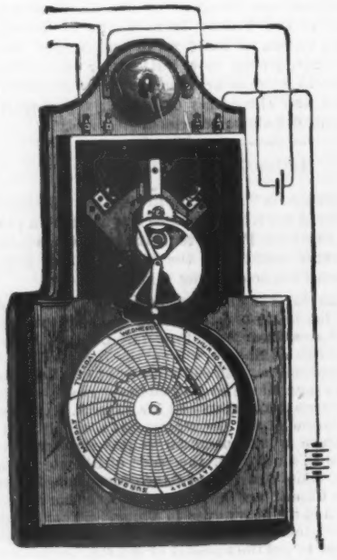


Fig. 2. Receiver.

Another adaptation of the telethermometer, not shown, is where the pipe extension goes through the wall of a brick oven, and the thermometer spiral is inside. Wires lead from the indicating transmitter on the wall outside to the receiving instrument at any distant point. This instrument with suitable pipe fittings is adapted to feed-water pipes, and tanks of every description. The extension pipes are made any required length up to 30 ins.

Still another adaptation is to place a telethermometer in a mine, recording the indications above ground. The temperature inside of closed kilns of every description can be shown in the same way, and the temperature of various points inside of kilns. There may well be irregularities of heating capacity in kilns, hitherto unsuspected, which are thus made known and can easily be remedied. By attaching the telethermometer to the injection pumps of seagoing steamers, and placing the receiver on the bridge, the temperature of the water through which the vessel is going can be had at any time, and timely warning can be given of the proximity of icebergs. These instruments are made by the Standard Thermometer Co., of Peabody, Mass., from whom further information can be had.

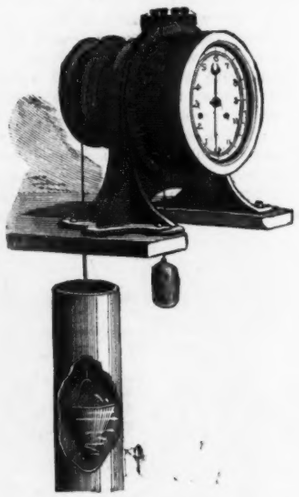


Fig. 3. Telemanometer.

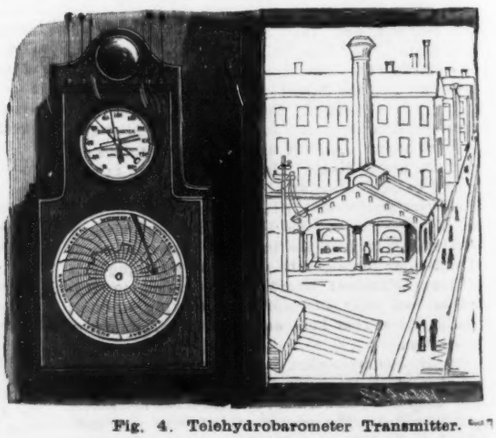


Fig. 4. Telehydrobarometer Transmitter.

They seem to be a class of devices well adapted to many different uses in engineering practice.

A NEW SYSTEM OF GRAIN STORAGE has recently been devised, which works somewhat on the principle of the "silo." The grain is placed in steel bins, and the air which permeates the mass between the separate kernels is replaced with carbonic acid gas. Heating, decay, or injury by must, with this surrounding medium, is said to be impossible.

The Plant of the Illinois Valley Electric Light & Power Co.

One of the longest incandescent light circuits in existence has been erected the present season by the Illinois Valley Electric Light & Power Co., of Ottawa, Ill. The company was organized last April with a capital stock of $20,000 to establish an incandescent electric lighting plant in the city of Ottawa, Ill. The company had to meet the competition of a company already established, operating both arc and incandescent circuit in Ottawa, and controlling the water power rights along the Illinois river for a considerable distance. There was, however, an excellent water-power at Marseilles, 8 miles distant, and after canvassing the cost of a steam power plant it was finally decided to erect the works at Marseilles and adopt the Heisler long distance incandescent system.

Work was pushed as fast as possible, and in August the plant was placed in successful operation. At Marseilles a dam was erected, 980 ft. between bulkheads, raising the Illinois river 7 to 14 ft. and setting back the water a distance of 20 miles. Two New American turbines were placed in the wheel-pit and connected to a Heisler dynamo of 700—30 C. P. capacity. For the trunk line wire No. 8 B. & S. gauge was used, hard drawn and weather proof.

The total length of the circuit is about 45 miles. It is 8 miles from the dynamo station to the first light in Ottawa. The light is as brilliant and steady at points of the circuit farthest from the dynamo as it is in the power station. In Ottawa the company has now 300—30 C. P., 150—20 C. P., and 100—15 C. P. lights, besides 20 lights ranging from 40 to 100 C. P. In Marseilles the company is now running 15—30 C. P., 50—20 C. P., and 20—15 C. P. lights, and it is expected soon to supply the city with 15 street lights, and also to secure a contract for street lights in Ottawa. A circuit is also to be put in to supply Seneca, Ill., 5 miles east of Marseilles, with electric lights. The accompanying map shows the location of the several towns supplied.

The feature of great interest in this plant is the length of the circuit and the area which it covers. In the early days of electric installations great stress was laid on the facility with which water-power located at remote and inaccessible points could be utilized to furnish light or power at the points desired, many miles away. With most of the systems in use, however, it has been found that the cost of the great amount of copper, required for the large wires which were necessary in long circuits, prohibited the placing of the dynamo at any considerable distance from the point where the current was to be utilized. By the Heisler system, as is proved by the above installation, this difficulty is to a large extent overcome; and the utilization of water-power, distant several miles from the point where the electric current is desired, is now quite feasible. There can be little doubt that this will lead to the utilization of many water-powers which are too remote to be of any use for other purposes.

It is not known that any longer incandescent circuit, or even any longer arc circuit, is now in operation; and the fact that this circuit is operated with so small a wire gives proof of the economy of the Heisler system in cost of copper.

Among other installations of the Heisler system now in progress, one of the most novel is for the Standard Light & Power Mfg. Co., of Montpelier, Vt. A 300—30 C. P. plant is being erected here, and the lights are to be rented at a distance of 4 miles from the station. A plant of the same capacity is being put in at Ludington, Mich., where arc lights alone have been used heretofore. Plants are also being erected for the Globe Furniture Co., Northville, Mich., and in the Farmers' Market Building on North Broad St., Philadelphia, Pa. A plant is nearly ready for shipment to London, which will be the first Heisler installation in England.

The Proposed Lighthouse on the Outer Diamond Shoal.

One of the most difficult pieces of lighthouse construction ever undertaken is proposed for next summer, and is described at length in a recent issue of the *Times*. It is the aim of the Lighthouse Board to establish, eventually, a line of light stations along the whole seacoast of the United States, with the lights so close together that a vessel sailing along the coast will never be out of sight of a beacon, and by consulting a chart giving the characteristics of the different lights can always determine her exact whereabouts and thus avoid dangerous rocks and reefs. How nearly the Board has succeeded in carrying out this plan, especially on the Atlantic coast, can be seen by a glance at the map accompanying their last annual report to the Secretary of the Treasury.

At the first glance it would seem that the Atlantic coast had about all the protection that is needed, and yet the most dangerous point on the entire coast, where, in almost every storm, vessels are driven ashore and lives and property are lost, is entirely without protection. This point is known as the Outer Diamond Shoal, 7½ miles off Cape Hatteras. It has not been neglected because its importance has not been appreciated, but because of the almost insurmountable obstacles in the way of locating a light there. A lightship could not possibly ride out the storms on this shoal, and it has even been impossible to secure whistling buoys there. Therefore, the only warning that sailors have had for years has been the Cape Hatteras light, which has been of comparatively little value in keeping vessels off the shoals, because it is so remote, and often obscured in thick weather.

Map of La Salle County, Ill., showing Location of Plant of the Illinois Valley Electric Light & Power Co.

The lighthouse authorities have studied the problem for years, and the most expert engineers in the Government service have looked the ground over, and the conclusion has at length been arrived at that a lighthouse must be built on the shoal itself. The Lighthouse Board has secured an appropriation of $500,000 for the work, and plans are now being prepared which, if successfully carried out, will result in a great feat of engineering. This shoal is a bank of shifting sand 7½ miles from the nearest land, over which the breakers wash with such force that anything less firm than solid rock would be quickly carried away. Work can only be done when the wind is off shore, and when the work is once commenced it will have to be carried up to a point considerably above water before a change in the wind, else all may be lost. The plan adopted by the Board is the same that was successfully used in the construction of the lighthouses at the Rothmond, on the Holland coast, and on Fourteen-foot Bank, in Delaware Bay. In both of these instances, however, the work was comparatively simple, owing to their accessibility and less danger of interruption by storms.

An immense caisson about 100 ft. in diameter will be built either at Norfolk or in Hatteras inlet. From the center of this caisson an iron cylinder about 50 ft. in diameter, will be carried up to such a height that when the caisson is sunk in position it will project above the surface of the water. When this is completed, it will be towed out to the site of the proposed light station, where it will be sunk until its edges rest on the sand. Then the work of excavating by sand pump inside the caisson will be carried on as rapidly as possible by several sets of workmen, relieving each other at short intervals. As the excavation progresses, the caisson will sink into the sand until a sufficient depth has been reached to give a firm foundation. This will probably be about 35 to 40 ft. below the surface, and it will require several days of continuous good weather to attain it.

When this part of the work has been finished the caisson and the cylinder will be filled with quick-setting concrete to such a height as the force of the breakers would be felt in the most severe storms. This will make the structure practically a monolith, and even though the shifting sands should scour the iron cylinder completely away, it will stand as firmly as before. Every precaution will be taken, however, to protect the structure from the action of the sea, and hundreds of tons of rip-rap stone will be heaped about its base.

The concrete will extend to about 40 ft. above the sea level, and above this the iron cylinder will be continued until it reaches a height of 100 ft. where the light will be placed. The work will be comparatively easy after the base is in position, but it is in towing the caisson out to the shoal and sinking it that the greatest care will be required. In towing out the caisson, which will draw between 15 and 20 ft. of water, it must be lifted over an 8-ft. bar by camels, pontoons, or some such appliances. Then, when the site is finally reached, the crowning difficulty will come in getting it sunk evenly and quickly into the sand. The slightest mistake then may be fatal, and if the work is not all done and the cylinder filled with concrete above the sea level before a hard blow from the sea, the whole thing will be lost, and work will have to be begun anew. The months of June, July, and August are considered the most favorable for working on the shoals, and, indeed, the only ones in which the work can be undertaken.

The board will advertise for proposals this winter, and let the contract as early as possible, so that the contractor can have his caisson completed and collect all his materials at a convenient place, and can take advantage of the first day next summer when the meteorological conditions indicate that the wind will be off shore for several days. It is hoped that, if the weather is favorable next summer, the lighthouse will be entirely completed and the light established before the storm season sets in next fall.

BRIDGE TRAFFIC.—A recent statistical publication of the city of Berlin gives information concerning the number of persons who daily pass along the most crowded thoroughfares of Berlin, London, and Paris. In the Leipziger strasse, Berlin, between the Leipziger platz and the Wilhelm strasse, in February, 1878, there passed 43,014 persons every 18 hours; on the Jannowitz Bridge, during every 18 hours in December, 1883, there passed 36,000 persons. At the same time some 80,000 persons passed over the Oranien Bridge. In April, 1884, 58,743 passed every sixteen hours through the Münz strasse between the Grenadier and the Kaiser Wilhelm strasse. In the same month the number of pedestrians in a short stretch of the Getraudten strasse was 47,506 every sixteen hours. The daily travel of pedestrians over the London bridges is estimated to be: Over London Bridge, 110,525; Blackfriars, 79,198; Westminster, 44,460; Waterloo, 32,815. In the work, "Les Traveaux Publics de France," (Paris, 1874,) the number of persons daily crossing the Pont Neuf, in 1842 already 80,000, is estimated to be about 150,000.

Diagram for Estimating Cost of Sidings.

We are indebted to Mr. M. L. BYERS, Assistant Engineer of the Pennsylvania Company, for the accompanying convenient diagram for estimating the cost of sidings. It is made as follows: First make a careful estimate of the amount and value of the material in each of the turnouts in common use, which are for Nos. 6, 8, and 10 frogs on most roads—the turnout being considered as extending from the switch point to the end of the switch ties.

Lay off on a piece of cross-section paper the length of lead vertically and the cost of material and labor for the switch proper horizontally to any convenient scale, thus locating the points *a*, *b*, and *c*. Next compute the value of the material and labor of laying, say 500 ft. of track, such as is used for sidings—generally old material, etc. Add this length to the length of the turnout, and the cost to

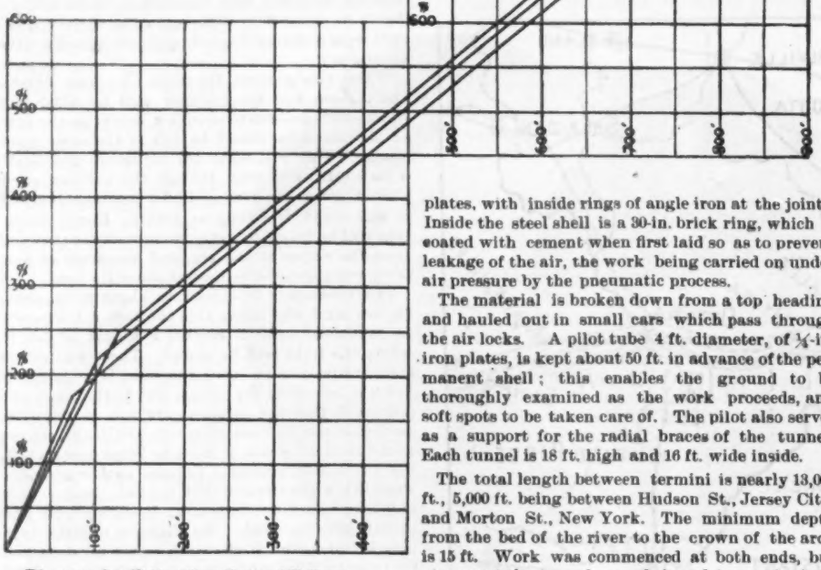


Diagram for Estimating Cost of Sidings.

the cost of the turnout, and plat the point *d* from these figures in the same manner that *a*, *b*, and *c* were platted. Through the two points so located draw an indefinite straight line, and through the points *b* and *c* draw lines parallel thereto; then, the length of siding and kind of turnout being given, the cost can be told at a glance.

The diagram gives the cost as built on the Erie & Ashtabula division, using 15 ft. split points, Pennsylvania Steel Co. automatic safety switch stand with intermediate signal, stiff-keyed frogs, and new 60-lb. steel rail in the lead, the remainder of the siding being laid in old steel of the same weight.

The principle of this diagram, we may note, may be used with immense advantage for comparative and preliminary estimates of all kinds, as for instance, culverts of various sizes, fills, iron trestles and wooden trestles, etc., etc. We urgently recommend the use of such diagrams *in all cases* for preliminary estimate purposes, not only because of the saving of labor (which may not in all cases be great) but because of the greater certainty of correctness, and the comparison between alternate modes of construction which is made so easy.

The Hudson River Tunnel.

The Hudson Tunnel Railway Co., which is now practically an English company, with Sir JOHN FOWLER and Mr. BENJAMIN BAKER, the eminent English engineers, as consulting engineers, has resumed work on the tunnel under the Hudson river which is to bring trains from the west side of the river to a New York terminus, thus saving passengers the inconvenience of the present ferry transfer system. Work has been stopped for some few years, owing to financial difficulties, but the English company will probably push it to completion. About $1,050,000 has already been expended. The great trouble with the project is the small capacity which the tunnel will have when finished.

The projector of the tunnel was Mr. D. C. HASKINS, who designed the method of driving now employed, and who has supervision of the work. On each side of the river a shaft has been sunk; the one on the west side is 65 ft. deep, 30 ft. inside diameter, with 4 ft. walls. There are two parallel single-track tunnels, each lined with 3-16 in. steel plates, with inside rings of angle iron at the joints. Inside the steel shell is a 30-in. brick ring, which is coated with cement when first laid so as to prevent leakage of the air, the work being carried on under air pressure by the pneumatic process.

The material is broken down from a top heading and hauled out in small cars which pass through the air locks. A pilot tube 4 ft. diameter, of ¼-in. iron plates, is kept about 50 ft. in advance of the permanent shell; this enables the ground to be thoroughly examined as the work proceeds, and soft spots to be taken care of. The pilot also serves as a support for the radial braces of the tunnel. Each tunnel is 18 ft. high and 16 ft. wide inside.

The total length between termini is nearly 13,000 ft., 5,000 ft. being between Hudson St., Jersey City, and Morton St., New York. The minimum depth from the bed of the river to the crown of the arch is 15 ft. Work was commenced at both ends, but at present the tunnels are being driven only from the New Jersey end. At the New York end, when work was suspended in 1882, the south tunnel was only commenced, while the north tunnel was advanced 150 ft. At the New Jersey end the south tunnel was 600 ft. and the north tunnel 1,845 ft. long. It is the north tunnel which is now being advanced, but it is expected that work at the four headings will soon be started. The average progress of the completed tunnel is about 3 ft. per day.

In the north tunnel, New Jersey end, there are two air locks. At 1,300 ft. from the shaft is a brick bulkhead 4 ft. thick, braced by diagonal timbers, and having an iron cylindrical passage 16 ft. long and 6 ft. diameter. Two doors are fitted, and have glass panels to enable written messages to be communicated without opening the air lock. On the working side of the bulkhead the air pressure is maintained at about 25 lbs. per sq. in. The second air lock is in a bulkhead close to the working heading, the pressure in front of it being about 32 lbs. per sq. in. The brick ring is kept close up to the end of the work, being built in sections of 10 ft. 9 ins. in length, or the length of four of the steel rings. The material is a silt, easily workable like clay, and impervious to both air and water.

Before work was recommenced, a hole in the roof had to be closed, which had been caused by the caving in of the river bottom over the end of the tunnel. A large pile of stones and bricks, surrounded by bales of hay was made up into a ball-shaped mass, wrapped with sail-cloth and bound with wire rope; this ball, weighing about 25 to 30 tons, was taken by a floating derrick, lowered into the hole, and weighted down by stones, etc., dumped upon it. The work has now advanced beyond this place.

While a double-track tunnel will hardly have sufficient capacity to handle all of the very heavy terminal traffic, it will be a great convenience, and will have plenty of traffic as soon as it can be opened. Extensive terminal facilities will be required, but it is early yet for any consideration of this matter in detail. We certainly hope the tunnel will be carried to completion without further delay.

The Ramie Plant: A New Source of Textile Fibre.

At different times during the last twenty years more or less interest has been excited over the cultivation of Ramie, a fibre-producing plant of great inherent merit, but one which has thus far failed to meet the expectations of its promoters, principally on account of the difficulty in separating the fibre from the stalk.

The Ramie plant is a perennial shrub whose stalks, growing as large as a man's finger, are covered with a bark composed almost wholly of long, tough fibres, which, when removed, bleached, and spun and woven, form a fabric with the strength of linen and a lustre almost equalling that of silk. It is applicable for every purpose for which linen is now used, making a much finer, softer, and more beautiful fabric, and in very many cases where silk is now used it can replace to advantage that expensive textile material.

About twenty years ago great interest was aroused in the South over this plant. On account of the troubles with the freedmen, Southern planters were eager to secure a crop which could be raised with less manual labor than cotton; and great stories were told of the productiveness of Ramie and the profit from its culture. A few plants brought from Mexico, where it had been introduced some years before, were sold at high prices; but when the plant began to be raised on a commercial scale, it was found that even Yankee ingenuity was unequal to the task of devising a machine to separate the fibre from the stalk, and its cultivation was abandoned.

Nevertheless, the remarkable productiveness of the Ramie plant and the excellence of the fibre which it produces renders it quite probable that it will yet take its place at the head of textile-producing plants. Its cultivation will be practicable as soon as a machine shall be devised which will cheaply and effectively separate the fibre from the stalks The writer of the following article asserts that such a machine has now been produced,—a statement which we sincerely hope to be true, although the cry of "wolf" has been heard so often before, if we are rightly informed, that we should prefer to have the machine tested for some time before embarking largely in the cultivation of Ramie. Whether the machine is a success or not, it seems pretty certain that human ingenuity will yet prove equal to the task of devising one that will be a success; and this done, the future of Ramie is certain.

The following description of Ramie and its prospects was prepared for this journal by Mr. JOSEF ZERVAS, of 570 Park Ave., New York.

During the last thirty years considerable importations of Ramie into Europe have been made under the name of Rhea, "Chinagrass," or Ramie, the product of a plant which botanists term *Boehmeria*. The name Ramie, however, is generally used, hence we have: White Ramie, *Boehmeria nivea*; Green Ramie, *Boehmeria utilis* or *tenacissima*.

The *Boehmeria nivea*, or white Ramie, is of Chinese origin, and belongs to the temperate zone. Its fibre is in more general use than that of the other, it is rougher to the touch, is not so full, and bears less resistance to tension. The stalks do not grow so high, and numerous side branches render pruning more difficult. On the other hand, the plant resists the cold better. The *Boehmeria utilis*, or *tenacissima*, or green Ramie, comes originally from the equatorial districts of Java. It is called *tenacissima*, on account of the great strength of its fibres; the plant is more prolific in fibrous material than the other; it is more easily grown, and reaches maturity at an earlier period. The average height of stalk of the green Ramie is 5½ to 6 ft., while that of the white Ramie is considerably less, being about 4½ ft. For these reasons the product of the green Ramie is superior to that of the white Ramie, although cultivation of the latter may be advisable in northern countries.

No country is better adapted for the introduction and cultivation of Ramie than the United States, which, owing to its extensive territory, affords all possible conditions for cultivation, as regards either soil or climate. It is not difficult to imagine the importance which this new industry may gain in the United States, when we consider that in 1887

the total importation of textile material (flax, hemp, jute, and other vegetable substances) from foreign countries into the United States amounted to about 123,000 tons, representing a money value of $14,000,000.

A few words in regard to the profits of Ramie culture may be allowed. One acre planted with 5,000 roots of Ramie plants will yield, in the Southern States, as far up north as the thirty-second parallel, where three crops per year can be obtained, about 100,000 lbs. of green stalks, of which one-half is attributable to leaves. Of the 50,000 lbs. left for stalks, one-twentieth, that is 2,500 lbs., will represent cleaned fibre. The actual market price for good clean Ramie fibre is 4½ to 5 cts. per lb. Deducting 2 to 2½ cts. for expenses, this will show a clear profit of 2½ cts. per lb., or over $60 per acre.

The greatest difficulty experienced in this industry has been the want of a practical decorticating machine. The object of decortication is to separate the ligneous part and cuticle from the textile part, or the stalk from the bark. During the first two days after cutting the viscous liquor which is found between the ligneous part of the stalk and the bark, allows it to be peeled with facility. The Chinese and Indians simply employ their forefinger and thumb to peel the bark, while in that state. This is, of course, primitive, and machines based on that principle have always been found unsatisfactory. Many inventors proceeded as in the case of flax and hemp, by a kind of maceration called retting; but this proved unsatisfactory on account of the speedy putrefaction of the stems. Other inventors constructed machines with the view of abandoning retting. These decorticate the stems and do the least possible injury to the fibres.

Notwithstanding that large prizes were offered by the English Government as well as by the French Government for an absolutely satisfactory Ramie decorticating machine, up to the present time the full prizes have not been awarded. Even American ingenuity could not yet fulfill the requirements. At the Brussels Exhibition of 1888, however, I saw at work the new decorticating machine of NORBERT DE LANDTSHEER, from Paris, and, without hesitation, I declare it to be the most simple, complete, and inexpensive machine yet used for the decortication of either green or dry stalks. The decortication is accomplished without crushing, and the fibres are free from cuts; in the green without broken parts. The separation is perfect, and the product is free from waste in either dry or green peelings. The small machine is light enough to be worked in the field, requiring less than one horse power to run it. Of course, there will come other machines doing the same or even better work. However, the value of the De Landtsheer machines being established, there is no longer any doubt as to the success of the introduction of Ramie culture into the United States, where the conditions of soil and climate are so favorable.

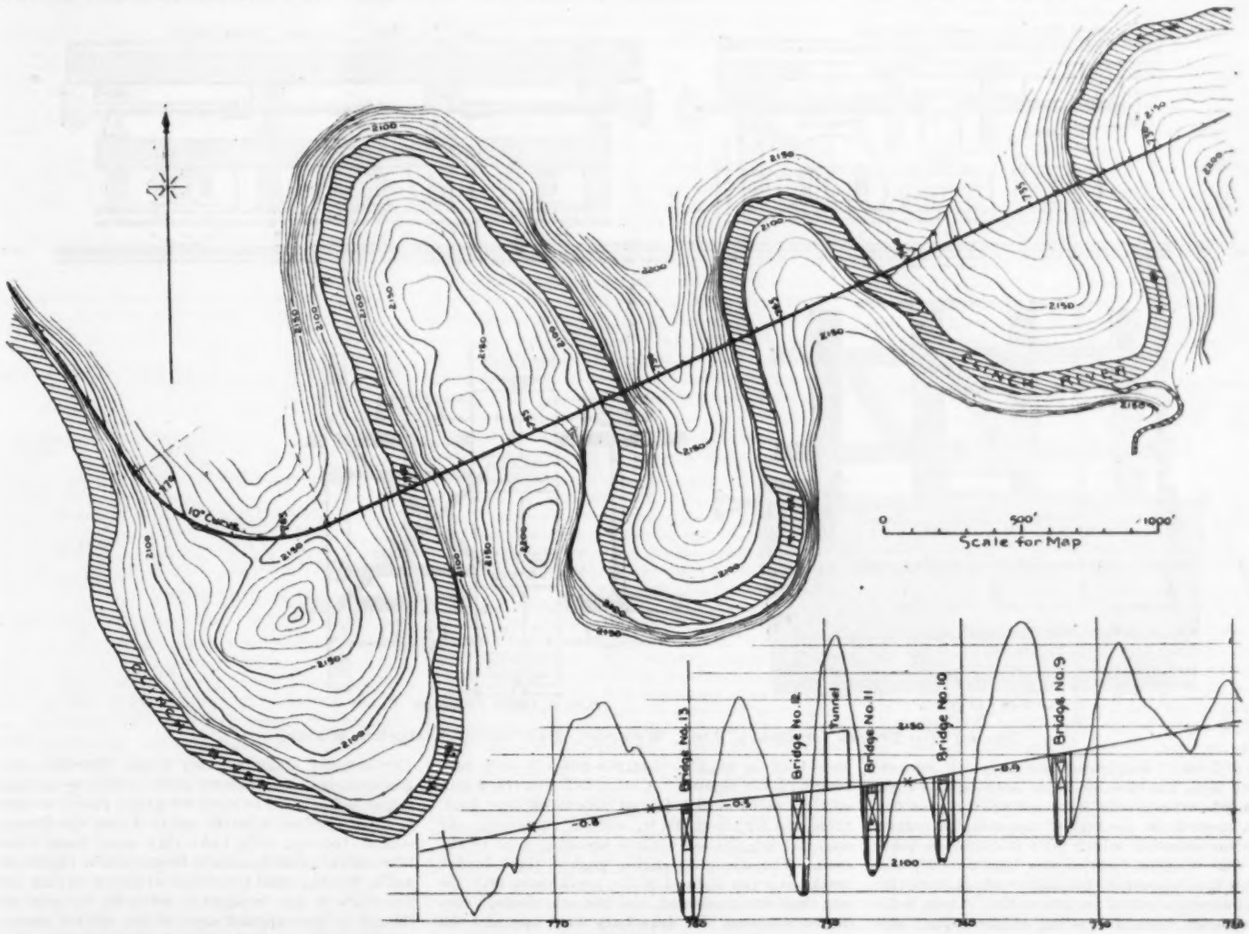
Since the above was in type, we have received information that a new process for decorticating Ramie has been perfected by C. F. PANKIN, a chemist of Charleston, S. C. Important details of the process are not yet made public; but the following is the general nature of the operation.

The stalks of the Ramie are first split longitudinally in halves. These slips are then passed through an apparatus similar to a fluting machine, which breaks the weed into small pieces easily detached from the bark, which is left in long ribbons. The secret lies in extracting the gum absolutely from this ribbon, removing at the same time all the finer particles of bark. It is said that the cost of preparation by the chemical process per bale or per pound will not exceed that for the preparation for the market of the equivalent amount of long cotton.

A CONVENTION is to be held at Huron, Dak., Sept. 27, to discuss the best methods for sinking artesian wells, building storage reservoirs and in other ways aiding and regulating irrigation. It is well known that in some sections of Dakota artesian wells have been very successfully constructed.

Curved vs. Tangent Locations.

We show by the cut herewith a map and profile of an interesting bit of location on the Clinch Valley division of the Norfolk & Western Railroad, of which line Mr. W. W. COE is the Chief Engineer. The work in question, which was located by Mr. EMILE LOW, Division Engineer, under the immediate direction of Mr. J. C. RAWN, Engineer in charge, comprises portions of Sections 31 and 32, and is situated about that number of miles west of Graham, the junction of the Clinch Valley with the New River division. The curve of the Clinch in the immediate vicinity of the mouth of Pounding Mill Branch is extremely sinuous and serpentine, the banks of the river being bordered here and there by high, precipitous limestone cliffs. A preliminary line was first run down the right-hand bank, and



Curved vs. Tangent Location, Clinch Valley Division Norfolk & Western R. R. W. W. COE, *Chief Engineer.*

also another along the left-hand one from a point a short distance above the mouth of Pounding Mill Branch to the first bend below, where it crossed the river, and was continued across a narrow neck to a connection with the first line. Spur lines were also run along the backbones of other bends. From these surveys an accurate topographical map was constructed. A careful inspection of this map developed the fact that only a bold location was the proper one for the place, and the tangent shown was decided upon. It crosses the river five times in its length of about half a mile, the crossings being known respectively as the ninth to thirteenth crossings of the Clinch River. The point between crossings Nos. 11 and 12 is pierced by a tunnel 155 ft. long, between faces of portals, and is driven through a solid limestone ledge. It was also intended to tunnel the point between crossings Nos. 9 and 10, but the material proved unfavorable, large pockets of earth occurring in the limestone formation.

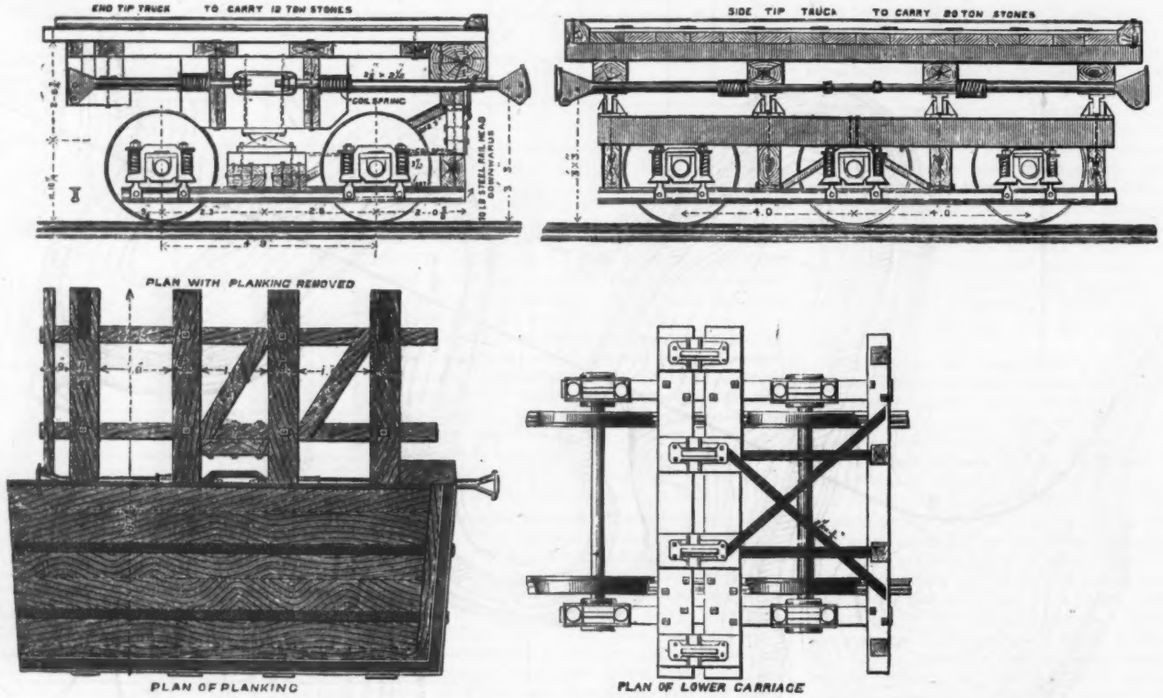
The river was bridged by means of Howe trusses, with short iron girders at each end, excepting Nos. 12 and 13, where the girders are replaced by trestle approaches. At these latter crossings the masonry

piers are only carried to a safe distance above high water, while at the other crossings they are brought to the grade line. The spans are 70 ft. under copings, except at No. 9, where the opening is 45 ft. The cost of the line shown, which approximates a mile in length, will be in the neighborhood of $76,000, the grading being $51,000, and the bridging $25,000.

The work is being done by contractor HENRY DAVIN, of Lexington, Va., the resident engineer being Mr. T. W. SIMPSON.

The line in question is well advanced and its entire completion is anticipated early next spring at the latest.

This interesting example of tangent location illustrates forcibly the advantages to be derived from *good* topographical maps, and also the fact that a tangent location is often cheaper than one which is a series of curves. Five bridges across the same stream are not very often required within a distance of 2,800 ft., but in this case they will be seen to have been unavoidable, since nothing less than 16° to 20° curves would have sufficed to pass the bends, apart from the highly objectionable nature of the line obtained, which puts it out of the question. The tangent location was here not only the best but the cheapest, as will often be found to be the case in careful study of such localities. There is no more common fault of locating engineers than the introduction of curvature in such localities as this, where there is really no necessity for it.


END TIP TRUCK TO CARRY 12 TON STONES
COIL SPRING
SIDE TIP TRUCK TO CARRY 20 TON STONES
PLAN WITH PLANKING REMOVED
PLAN OF PLANKING
PLAN OF LOWER CARRIAGE

Spring Tip Trucks for Heavy Rock, Westport, New Zealand, Harbor Works.

Spring Tip Trucks for Heavy Rock.

The accompanying illustrations for which we are indebted to *The Engineer*, show a style of truck which has been used with great success on the Westport harbor works, in New Zealand, for hauling heavy stones 7 to 9½ miles. Both end-tip and side-tip cars are shown in the cuts, the end-tip carrying stones up to 12 tons in weight, or say 6 cu. yds., and the side-tip 20 tons. For very heavy rock work these cars have certain obvious good points.

At the commencement of the harbor works the Harbor Board possessed a stock of end and side-tip trucks of the usual kind without springs, which, being loaded with 8 and 14 tons, were found to be dangerous, on account of the numerous breakages of axles, besides damaging the road and rapidly knocking themselves to pieces. To meet this difficulty, and in view of the enormous traffic required of the trucks, the engineer, Mr. C. NAPIER BELL, M. Inst. C. E., designed the trucks shown in the drawings. These trucks have been running for nearly two years, and have answered every purpose expected from them. Their strength and endurance are said to be very remarkable, and considering the exceedingly rough usage they are subjected to, this can only be accounted for by the extreme flexibility of the trucks, which not only prevents their receiving damage, but has the still greater advantage of making them very safe against leaving the rails.

It will be observed that the end-tip has 8, and the side-tip 12 coil springs, and as it takes about 4 tons to set one spring down, the trucks are abundantly elastic. The effect of this is that they carry more than 50 per cent. greater load than ordinary trucks without springs, with safety to the axles and the road. As examples of the working of the cars: A 4-ton stone slipped out of the slings and fell from a height of 2 ft. on the floor of an end-tip truck; the truck was not damaged, except that the steel rails were bent so slightly that the truck is still running without repairs. A stone fell off a truck in a cutting and forced 5 loaded trucks off the road; these ran for about 200 ft. without sustaining any material damage and without breaking a tie in the road. The dumping engine pushed three loaded trucks over the tiphead of the breakwater into the sea; they were recovered, and the only damage sustained was that the draw-bars were bent and the woodwork of the backs stove in.

The first constructed of these trucks have been in use over two years; each truck has run 7,600 miles, and carried 4,800 tons of stone without damage or repairs. The quantity of stone required to be carried to complete the work is about 1,000,000 tons. There are 120 of these trucks in use on the works: the wheels and axles are the ordinary New Zealand Railway pattern, the load on which is usually restricted to 5½ tons per axle, but these trucks carry 8 tons per axle with safety.

Notes on Irrigation.

There is a rapidly increasing general interest in the existing irrigating systems of the West and in the efforts which are being made to determine the best methods of watering the vast areas of the arid regions. Naturally the interest in the West is by far greater than that elsewhere, but the development of the millions of acres which now lie, year after year, parched and unproductive is a problem worth the attention of all citizens of this country, and especially of the engineering profession. Mr. CHAS. L. STEVENSON, C. E., of Salt Lake City, has recently contributed to the *Tribune* of that city several letters treating of the local and general bearings of irrigating questions. From these letters we select such facts and suggestions as will be most interesting to our readers.

PROPOSED INCREASED IRRIGATION AND GENERAL PUBLIC WATER SUPPLY FOR SALT LAKE CITY.

The first of Mr. STEVENSON's letters related to the water supply of Salt Lake City, both for irrigating and domestic purposes, and was originally addressed to the Chamber of Commerce. In this letter Mr. STEVENSON states that the city has within its corporate limits an area of 6.5 sq. m., exclusive of streets, all of which must sooner or later be supplied with water, not only for general public use, but also for irrigating purposes. The present population of the city is about 40,000. The city has whole or partial control of four sources of supply, three of which have an available daily capacity in low summer stages of: City creek, 19,000,000 galls; Emigration creek, 1,500,000 galls., which by storage might be increased to 10,000,000 galls.; Parley's creek 82-100 of the flow, 5,750,000 galls. From the fourth source, through Salt Lake City canal from Utah lake, there might be a daily flow of about 124,000,000 galls., but the canal is now out of repair, so that for five years it has brought no water to the city, although it has supplied some of the ditches above. This makes an available supply of 26,250,000 galls., which might be increased 10,000,000 galls. by a storage reservoir on Emigration creek, and 124,000,000 galls. by repairing and keeping in good order the Salt Lake City canal.

If the whole city were irrigated, there would be required a daily supply of 27,000,000 galls., but it will probably be some time before this is the case. Mr. STEVENSON deems advisable the construction of an 80,000,000-gall. reservoir on City creek, at a point known as Little valley. This would be primarily for distribution, but it would increase the daily supply through the dry season by over 600,000 galls., and at the same time would afford a water-power which could be utilized for generating electricity to be transmitted to the city.

Another recommendation is that the natural flow of springs along the above-named streams be "aided" by clearing away from them the material at their mouths, a method which has been successfully employed at other springs. It seems that by constructing storage reservoirs at advantageous points, from time to time, the available water supply can be increased as may be needed.

Cost and Duty of Irrigating Canals in this and other Countries.

The following tables were originally compiled by A. D. Foote, Chief Engineer of the Idaho Irrigation Co. The data regarding the Colorado and Utah systems were added by Mr. Stevenson, and the figures were obtained by him mostly from M. J. Mack and Walter H. Graves.

COST OF IRRIGATING WORKS FOR EACH ACRE IRRIGATED AND FOR EACH CUBIC FOOT OF WATER USED PER SECOND.

Canal or District.	Locality.	Per Acre Irrigat'd	Per cu. ft. per second of water used.
Cajon Canal	California.	$53.33	$1,025.64
Santa Clara Valley Irrigation Co.	"	9.68	543.82
Riverside Canal	"	32.75	1,507.14
Mussel Slough country	"	7.30	583.65
King's River Country, N. side	"	7.18	277.20
Carpediers Canal	France.	35.67	2,830.19
Verdun	"	81.25	15,330.19
Hanares	Spain.	40.66	7,500.00
Del Norte Canal	Colorado.	3.75	312.00
Uncompahgre Canal	"	3.30	250.00
High Line Canal	"	10.80	549.00
Loveland and Greely	"	6.80	386.30
Montezuma Valley Canal	"	9.67	967.00
Dolores Canal No. 2	"	8.33	416.66
Bear River Canal	Utah.	4.00	400.00

THE FINANCIAL CONDITION OF VARIOUS CANALS AND IRRIGATION DISTRICTS IN INDIA.

Canal or District.	Total Cost of Works.	Number of Acres Irrigat'd	Cost of Works per Acre Irrigat'd	Int. on Investment.
				per ct.
N. W. Provinces.	$17,827,225	.. .. ..	.....	5¼
Punjaub	15,671,000	.....	.....	5
Madras	9,467,200	.....	.....	22¾
Ganges Canal	14,780,272	1,045,013	$14.15	6
Bombay and Scinde.	11,113,940	.....	.....	12
Eastern Jumna	1,264,377	206,732	6.11	23
Western Jumna	6,532,000	507,974	10.88	19½
Godavery Delta	3,418,535	1,000,000	3.42	39¾
Kistnah Works	2 337,135	470,000	4.97	13¼
Cauvery	1,463,000	835,000	1.75	36½
Scinde Inundation.	5,930,000	.....	.....	18½

The revenues from some of the Indian canals are small, owing to the fact that the canals were constructed partly for navigation. The entire investment, in 1881, of the Indian Government in canals was $86,000,000, and the area irrigated, 8,000,000 acres, making the cost per acre $10.60. The net revenue from all the irrigating works was 5.2 per cent. on the total capital invested. It will be seen from the tables that for the Indian canals the lowest revenue was 5, and the highest, 39¾ per cent. of the total cost.

It will be seen from the tables that in India the cost per acre irrigated, for the irrigating works named, varies from $14 15 to $1.75; that in France the cost for the two works named was $81,25 and $35.67; that in California the cost varies from $53.33 to $7.18; in Colorado, from $10.80 to $3.30; and that for the Bear River canal, Utah, the cost per acre irrigated was $4.00.

One of the most important problems in connection with irrigation is the duty of the water used, or the number of acres that 1 cu. ft. of water per second will irrigate. Of instances cited, the duty varies greatly, it being 250 acres on the Eastern Jumna canal in India, water first running 300 miles before it is used, and being measured at the head of the canal, without allowance for evaporation. In Italy the average for the whole country is 70 acres to 1 cu. ft. In designing the works of the Idaho Irrigation Co., near Boise City, Mr. A. D. Foote assumed a duty of 100 acres, and on this subject says:

Judging from the history of other countries, when better methods in the distribution and application of water shall have been adopted, and experience shall have taught the value of an economic and discriminate use of it, its duty, no doubt, will be increased to from 100 to 130 acres per cubic foot.

In all plans for the storage of water and its distribution through open ditches, a considerable allowance must be made for evaporation, especially in the arid regions. Very recent measurements at the Great Salt Lake show a daily evaporation of 0.26 ins., or about 1 in. in four days. Mr. Stevenson states that for ordinary irrigating, water should be applied about once a week equal in amount to a depth of 1 in. over the whole area. Thus, at the above rate, the evaporation from a body of water would be sufficient in quantity to irrigate double the area of the evaporating surface.

It is estimated that an acre of irrigated land will produce one ton of freight, a fact that should be borne in mind by those interested in railways passing through unirrigated land.

The cause of the slow development of irrigating systems in this country is attributed to the fact that for a few years no returns can be expected from capital thus invested; and herein, says Mr. Stevenson, lies a reason why our National Government should take an active part in the matter, as has been done so successfully in foreign countries.

Some of the Recently Constructed Irrigation Works of Colorado and California.

The irrigating works of Utah are mostly of a crude nature, consisting mainly of canals or ditches leading directly from the streams. The total mileage of the ditches, great and small, is in excess of that of some of the other Territories, but California, and Colorado especially, have works of far greater magnitude and cost. The latest official returns for Utah were in 1875, when there were 2,085 miles of main, and 4,888 miles of minor irrigating ditches. It is estimated that there is now a total of 10,000 miles of such ditches. In Colorado, June, 1886, there were about 800 miles of large canals, and 3,500 miles of smaller ones, and these had cost, respectively, $5,000,000 and $3,000,000. Since, June, 1886, about $3,500,000 additional has been expended, making the cost of both classes $11,500,000. These canals irrigate about 2,800,000 acres, making the average cost per acre $4.10. Nearly all of these ditches have been constructed since 1880.

The following descriptions of two Colorado canals are from one of Mr. Stevenson's letters:

High Line Canal.—As now completed, the main line is 70 miles long, with a branch of 15 miles, starting 51 miles from its source. For 46 miles of its length the canal is 40 ft. wide on the bottom and 7 ft. deep, with a grade of 21 ins. to the mile. For the remainder of its length on the main branch, the width varies from 35 to 20 ft. and the depth from 7 to 4½ ft., the grade being uniformly 32 ins. to the mile.

Some of the engineering features are worthy of note. The main dam is of timber 120 ft. long by 14 ft. high. The wasteway is 24 ft. wide over walls, the full depth of the dam, and built entirely of masonry, the gates and fittings being of iron. The head gates proper at the mouth of the tunnel are 25 ft. wide and 12 ft. high, with five openings, the gates being operated by screws. The tunnel is 600 ft. long, 20 ft. wide, and 12 ft. high, with a grade of 5.28 ft. per mile. Starting from the lower end of the tunnel, and continuing for a distance of 2,700 ft. is a flume resting on a bench cut out of the rock. This bench was cut 36 ft. wide, the flume resting on it is 28 ft. wide and 7 ft. deep, with a grade of 5.28 ft. per mile. There are also two other flumes 918 and 810 ft. long. These are 36 ft. wide and 7 ft. deep.

The cost of construction was $650,000. The appropriation of water for the canal is 1,184 cu. ft. per second. On the Colorado basis of 1.44 cu. ft. per second to every 80 acres, this would be sufficient to irrigate 60,000 acres.

The Del Norte Canal.—This is the largest irrigating canal in the United States. It is 65 ft. wide on the bottom at the head gate, carrying water 5½ ft. deep, with side slopes 3 to 1, making the top width at water line, 98 ft. Four miles from the head it is bifurcated; the larger branch being 42 ft. wide on the bottom and the smaller 38 ft. wide. There are about 50 miles of main channel. It carries something over 2,400 cu. ft. of water per second and is calculated to irrigate over 200,000 acres. It is located in the San Luis Valley in southern Colorado, takes its supply from the Rio Grande, and covers the land in the northern end of the valley. It cost over $300,000.

The peculiar feature in the construction of this canal was the rapidity of its completion, the entire work having been accomplished within a period of four months.

The preliminary surveys were begun on the 10th of December, 1883, and the canal was completed the 1st of the following April. Something over 1,400,000 cu. yds. of material were excavated to form the channel, requiring between 4,000 and 5,000 laborers and 1,200 teams. The 220,000 ft. of timber used in the structures of the canal was cut from the mountain side, sawed, framed, and placed between the first of January and the first of March. For so large a canal, this has the excessive gradient of 8 ft. to the mile for 12 miles of its length, which is subsequently reduced, after leaving the foot hills, to 2.5 ft. per mile.

Mr. Stevenson states in this connection that from July 17, 1887, to Jan. 1, 1889, there were filed with the State Engineer of Colorado plats of 821 new ditches, and that the present year promises extensions at an equal rate.

In California a large number of abandoned mining ditches are being utilized to furnish water for agricultural purposes, but notwithstanding this there have been constructed within five years past a considerable number of large storage reservoirs. As notable among these structures, Mr. Stevenson refers to the Bear Valley reservoir in San Bernardino Co., which was described in Engineering News of June 23, 1888. This reservoir is formed by a huge masonry dam across the Bear valley, impounding 8,000,000,000 galls. of water, and flooding a strip of country about 5 miles long by ¼ mile wide to a depth of about 12 ft. The water stored by this reservoir is sufficient to irrigate an area of 50,000 acres, besides supplying 500,000 people with water for domestic purposes.

Irrigating System of Los Angeles, Cal.—Water is distributed from several reservoirs supplied from the Los Angeles river. Open ditches were formerly used, but to save evaporation and seepage these have been largely superseded by underground cement or iron pipes. There are now 13,240 ft. of 30-in., 26,500 of 24, 14,415 of 22, 1,200 of 10, and 2,500 ft. of 8-in. cement pipe; and there are 7,500 ft. of 22-in., 900 ft. of 12, and 7,000 ft. of 8-in. iron pipe, or a total of about 14 miles of pipe. Over 1,000 siphons and 100 wells have been put in, these being contrivances for checking or stopping the flow of water through the pipes and forcing it up and onto the land. It is said that the pipe lines have doubled the available quantity of water, and enabled the city to reduce the rates.

The duty of water for irrigating purposes in southern California has been greatly increased, it now being claimed that 1 cu. ft. of water per second will irrigate from 250 to 500 acres of land.

Irrigation in Utah Co., Utah.

The Utah County Court, Utah, has sent to the Governor a map 4 by 7 ft. in size, showing the lakes, rivers, creeks, springs, reservoirs, canals, ditches, and other topographical features of the county, of which the map is designed to give an exact idea of the irrigation status and possibilities. A table accompanying the map gives the names of the natural streams, with the appropriations of water therefrom, and the date and ownership of the appropriation. In the county there are under cultivation 69,126 acres, and 225,000 which could be cultivated if sufficient irrigating facilities were provided. Owing to a lack of water, crops have been lost this season on 28,985 acres of land.

The committee on the compilation of the map states that the average depth of snow in the mountains in winter is 4 ft., and that to produce one acre of crops in this section, 40,000 cu. ft. of water are needed during the season. In the wet season, enough water goes to waste on the east side of the valley, water that might be stored, to water all the arable lands on that side, while water from artesian wells might be had for the west side of the valley. Unfortunately the land is owned in from 5 to 20-acre lots by people too poor to build reservoirs or drive wells, so that government help is necessary for the development of the land, or at least to show the people the practicability of such development. Irrigation statistics of a similar character are being collected elsewhere in Utah.

An explosion occurred at the Edgar Thomson Steel Works, at Braddock, Sept. 26, by which Capt. Wm. R. Jones, General Manager of the works, was horribly burned, dying two days later, while seven workmen were seriously and perhaps fatally burned. Furnace C, one of the largest of the blast furnaces, gave way at the bottom, and in an instant flames shot forth, and the hot metal exploded, and fell like sheets of water.

Capt. Jones was well known throughout the United States and Europe wherever iron and steel are manufactured, and his untimely death will excite general sorrow and will be a loss to the works and to engineering not easily made good. He was 60 years of age, and his knowledge of iron and steel making in all its branches and interest in improving all processes, were very unusual, and will cause him to be long remembered.

The Coal Supplies of the World.

The Deutsche Handels-Museum has recently issued some interesting figures relating to the world's coal fields outside of the North American continent. According to these, the Low Countries, Switzerland, Denmark, Germany, and Bohemia, possess coal mines of a surface area of about 59,000 sq. miles. Russia alone has 22,000 sq. miles. The deposits of the island of Formosa amount to something like 10,000 sq. miles, some of the coal veins ranging up to 96 ft. in thickness. The coal fields of Austria, Spain, Portugal, Italy, Greece, Turkey, and Persia, cover about 39,000 sq. miles; those of India, 35,000; and those of Japan, 6,000 sq. miles; while those of China are estimated at the enormous figure of 400,000 sq. miles. Moreover, the Falkland Islands, Patagonia, and Peru are very rich in coal, while the southern part of Chili is one immense deposit. In Brazil veins varying in thickness from 17 to 25 ft. are found in abundance, and in the United States of Colombia there is an abundance of the mineral. Mexico and the Vancouver Islands are also well supplied, there being probably not far from 20,000 sq. miles; while the deposits thus far discovered in Tasmania, New Caledonia, and Natal are estimated to cover 100,000 sq. miles, the larger number of these deposits not yet having been worked. Without reckoning the immense stores of coal in the United States, and merely relying upon those given above, there seems to be but little prospect of a coal famine during the present century.

Better Pavements for American Cities.

The New York papers think the movement recently inaugurated there for better pavements and roads has come to stay. We sincerely hope so, for the honor of the nation. "What struck you most about American cities?" an Englishman traveling in this country was recently asked, and responded truthfully, "The bad pavements and the telegraph wires." These are the two greatest atrocities of municipal life, and the natural fruit of our city rings and combinations.

Perhaps, if New York, which is particularly bad in the matter of pavements, starts off to put them in better order, other cities will be disposed to follow its example; and the paving "boom" may even spread down here and overcome the objectors who killed the late drainage and paving bill.

The truth is that the pavements in American cities are bad, not wholly on account of their original and intrinsic badness, but because of their neglect. We lay a pavement and stop there, in defiance of the good old maxim, "A stitch in time saves nine." No repairs are ever made, and the consequence is that the pavement deteriorates far more rapidly than it would were a little attention given it.

In France, it is estimated that repairs call for an annual expenditure of from 3 to 5 per cent. on the original cost of the road or pavement. If we would but adopt a little of this French economy and common sense in this matter, it would help us largely to solve the problem; and the thorough paving of our cities would then not be beyond our means. It is absurd to pretend that a country like this, which claims to be the richest in the world, is unable to afford decent pavements.—*New Orleans Times-Democrat.*

THE FAILURE OF THE SOUTH FORK DAM, and of other similar structures, has drawn from Sir ROBERT RAWLINSON a letter to the London *Times*, in which he makes the following comments upon excessive floods:

Excessive floods may not occur annually, but at rarer intervals. In England rivers occasionally rise some 22 ft. or 23 ft. vertical in flood; in Scotland and Wales, some 30 ft. or 35 ft. in great spaces, doing great damage within the range of the flooded areas. In South Africa rivers rise 70 ft. vertical, and in parts of Australia 120 ft., a small and almost invisible stream in dry weather becoming a devastating torrent during the heavy rains. The rivers flowing down the Conemaugh valley in America from the mountains above will be subject to similar excesses. The great rivers and great lakes of North America and Canada have, however, capacity to equalize the effect of storms, and so to prevent such excesses as now and then take place over areas of less extent, and which will inevitably be repeated if similar mistakes are made, such as building towns, villages, and works in narrow valleys below wide mountain areas and large artificial reservoirs. There may be a very wide interval between the excesses of nature, but there is ever the contingency, nay, certainty, of a repetition, and man cannot alter it.

Notes on the Manufacture of Open-Hearth Bridge Steel.*

The specifications for bridge steel are usually not severe. The main difficulty is to secure a material which will roll easily, without showing signs of cracking on the corners of the blooms or on the flanges of the beams. In many mills sulphur has been deemed the most harmful constituent in this respect. It has been thought hazardous to roll steel containing over 0.07 per cent. of sulphur. Yet in making steel for the Phœnix Iron Co. I have produced from stock running as high as 0.13 per cent. of sulphur a material which rolled very satisfactorily. It is reasonable to infer that the injurious effect of sulphur can be neutralized to a great extent by proper treatment in the open-hearth furnace, and the following notes from my usual practice here may be of interest to those obliged to use high sulphur stock. The steel made at Phœnixville in the 20-ton furnace has about the following composition:

	Per cent.
Carbon	0.15 to 0.20
Manganese	0.50 to 0.60
Sulphur	0.11 to 0.13
Phosphorous	0.04 to 0.06
Silicon	0.01 to 0.02

The best running heats were made with a small amount of pig iron. In using large proportions of pig, the quantity of ore is also increased. This not only cuts the bottom, but also lengthens the time required to bring the charge down. Up to 50 per cent. of pig may be used, but 25 per cent. is much better. A 40,000-lb. charge, containing 10,000 lbs. of pig, and 30,000 lbs. of Bessemer butts or beam-scrap, works very well.

This is melted as quickly as possible. When ever particle of the charge is thoroughly melted and the bath is hot, ore is added. If the ore is added before the charge is all melted the cold ore chills the partly-melted metal, and much time and heat are needed to make the bath perfectly fluid again.

In a charge containing 25 per cent. of pig, 1,000 lbs. of hematite ore are usually required to bring the carbon to 0.16 per cent. This amount is weighed out, and "feeds" of 200 lbs. each are put in as fast as possible, the temperature of the bath being kept up. With the bath in good condition, all the ore may be put in within an hour. During the addition of ore, there should be a lively action throughout the metal, and before all the ore has been put in, an energetic "boil" should be visible all over the bath. The heat on the metal is now gradually increased, and the lively action is kept up for nearly an hour. With the decrease in carbon, the intensity of the action diminishes, and the slag becomes thicker and more viscous. At the end of onn hour after the last addition of ore the bath becomes very quiet, the bubbles of gas foamed are few and break slowly through the slag. The metal, if exposed to view, presents a clear, silvery appearance. A test taken at this time usually breaks with a bright, coarsely-crystalline fracture, showing considerable toughness. The carbon is near the 0.16 per cent. point. If it be a few hundredths higher the slight action in the bath will soon bring it to the desired point without further addition of ore. In case it be necessary, however, to add ore at this stage, sufficient time should be allowed after the ore has entirely disappeared for the bath to become tranquil before pouring. Steel treated in the furnace in this way should remain perfectly quiet in the moulds when poured.

The ferromanganese in small pieces is shoveled into the ladle while the stream is running out of the furnace This method of adding ferromanganese is most economical. The old way of throwing it into the furnace took twice the amount of ferromanganese to give the same percentage of manganese in the finished metal. In making low steel I have noticed a loss of two-thirds of the manganese when added to the bath before pouring. By adding ferromanganese in the ladle the loss is practically nothing. This steel seems to work better when poured cool; but a large number of hot heats have rolled very well. The temperature of the ingot when bloomed down is a good red heat, noticeably colder than is the usual practice. The steel is top-poured, making ingots 15 x 18 ins., in size, and weighing 4,300 lbs. each.

The following physical tests were taken at random from a large number of heats:

Physical Tests of Open-Hearth Steel (Test-Pieces 8 in. long, ¾ in. in diameter).

No.	Tensile strength Per sq. in.	Reduction of area Per cent.	Elongation Per cent.	Carbon Per cent.
1	57,100	65.3	25	0.15
2	64,100	62.6	26¾	0.18
3	61,200	61.	31½	0.18
4	66,700	53.8	24½	0.21
5	66,700	49.3	23¾	0.19
6	60,000	55.1	26¼	0.15
7	60,800	58.7	24½	0.13
8	67,500	46.3	24½	0.16
9	69,200	45.4	22½	0.22
10	60,320	54.1	30	0.17

It will be noticed that the increase in the percentage of carbon is not always followed by an increase in tensile strength.

*A paper by N. W. SHED, M. E., read at the Colorado meeting of the American Institute of Mining Engineers.

RAILWAY GAUGES IN AUSTRALIA.—The trouble in Australian railway traffic, from the fact that each colony has its own gauge, has often been noted, and various suggestions have been made from time to time for converting the systems to a uniform gauge. This was referred to in the article on "Australian Railways," in our issue of March 30, 1889. The question of overcoming the break of gauge on the railway line to the Barrier is now said to be earnestly considered by the South Australian Government, and inquiries are being made as to whether the New South Wales Parliament will permit of the line from Cockburn to Broken Hill being altered from a 3 ft. 6 in. to a 5 ft. 3 in. gauge.

PERSONAL.

Capt. GEO. SKINNER, Superintendent of the Chattanooga, Rome & Columbus R. R., died at Rome, Ga., on Oct. 1.

Mr. J. T. FANNING has been appointed Consulting Engineer of the St. Paul, Minneapolis & Manitoba Railway Co.

Mr. J. M. CARR has been appointed Master Mechanic of the Kentucky Union Railway, with headquarters at Lexington, Ky.

Mr. ALEXANDER LAIRD has been appointed Master Mechanic of the Ohio River Railroad, with headquarters at Parkersburg, W. Va.

Mr. V. H. STEVENS has been appointed Superintendent of the Atlantic & Danville Railway, to succeed Mr. A. D. BATEMAN, promoted.

Mr. F. C. SMITH has been appointed Master Mechanic of the Queen & Crescent shops at Chattanooga, Tenn., to succeed Mr. J. H. MCGILL.

Prof. ARTHUR WINSLOW, recently appointed State Geologist of Missouri, will begin the proposed State survey during the present month.

Mr. FRANCIS COLLINGWOOD has been appointed to examine the Chemung River at Elmira, and recommend measures of protection for the city against floods.

Mr. THOMAS A. LANE has been elected a member of the Board of Water Commissioners, of Manchester, N. H., for a term of six years, vice Mr. JOSEPH KENNARD.

Mr. GEO. TOZZER, formerly Purchasing Agent of the Cincinnati, Indianapolis, St. Louis & Chicago has been appointed Purchasing Agent of the Chesapeake & Ohio.

Capt. W. R. JONES, General Manager of the Edgar Thompson Steel Works, died at Pittsburg on Sept. 28, from injuries received in the accident at the works on Thursday, Sept. 26.

Mr. DANIEL ROBINSON, of Troy, N. Y., died on Sept. 24. He was President of the Troy & Boston Railroad for many years, and was the principal projector of the Hoosac tunnel enterprise.

Mr. FRED C. HILLS has been appointed General Superintendent and JAMES V. MAHONEY, General Traffic Manager of the Sioux City & Northern Railroad, the appointments to go into effect Nov. 1.

Mr. GRANT WILKINS, who has been Chief Engineer of the Atlanta Bridge & Axle Works, at Atlanta, Ga., since their organization, has resigned his position, his resignation taking effect Oct. 1.

Mr. M. V. MEREDITH, a former Division Superintendent on the Flint & Pere Marquette, has been appointed Superintendent of the Saginaw, Tuscola & Huron Railway, to succeed Mr. ROBERT LAUGHLIN.

Mr. W. D. EWING has resigned as General Manager of the Evansville & Terre Haute, Peoria, Decatur & Evansville, and Evansville & Indianapolis railroads, and the duties of that office will be performed by President D. J. MACKEY.

ROBERT GORDON, M. I. C. E., well known to many members of the Am. Soc. C. E., has resigned his position as Consulting Engineer to the Burma Ruby Mines Company, and has accepted a commission as an engineer in Siam.

MOFFETT, HODGKINS & CLARKE, the well-known water-works contractors, will remove their principal office on Oct. 10, from Watertown to Syracuse, N. Y. The branch offices at New York and Chicago will be conducted as heretofore.

The Grand Cross of a Commander of the Legion of Honor has been conferred upon Mr. THOS. A. EDISON by the French Government. M. SPULLER, Minister of Foreign Affairs, in conferring the decoration upon Mr. EDISON, said it was given in honor of the services rendered by him to science, and for the part taken by him in the Paris Exposition.

Mr. O. A. ROGERS has been appointed General Superintendent of the McKeesport & Belle Vernon Railroad, now in operation from Monongahela City, Pa., to McKeesport, 17 miles, to succeed Mr. JAS. RITCHIE. Mr. ROGERS has been in the service of the Pittsburg & Lake Erie since 1886, and was with the New York & New England prior to that time.

MR. CECIL GABBETT has been appointed General Manager of the Central Railroad & Banking Co. of Georgia, to succeed Mr. M. S. BELKNAP. Mr. GABBETT is a civil engineer of 20 years experience, and has been connected with Southern railways most of the time since 1870. Since 1886 he has been General Manager of the Western Ry. of Alabama, the Atlanta & West Point, and the Cincinnati, Selma & Mobile.

Major BELKNAP is also a civil engineer and has been engaged in railway work for a score of years. He has been Manager of the Central of Georgia system for 2½ years. He leaves railway work to accept the presidency of a bank in the city of Mexico.

Mr. P. M. MATTHEWS, of the firm of Matthews Bros. & Kerrick, of Minneapolis, general contractors, died at Butte, Mont., Sept. 20. The firm has the contract for the bridge construction and tracklaying on the Butte extension of the Northern Pacific, and Mr. MATTHEWS was superintending the work. Being curious to try the effects of opium smoking he induced a Chinese employé to prepare the drug, and, unaware of its power, he became unconscious, and died from the effects of an over-dose.

PUBLICATIONS RECEIVED.

— *Fifth Annual Inspection, Savannah, Florida & Western Ry.*, etc. H. S. HAINES General Manager.

This pamphlet report of the result of an admirable system of yearly track inspection has been lying on our table several months awaiting opportunity for notice. The inspection took place in December last. We noticed the corresponding report of last year soon after it appeared, and notice this also editorially.

— *Windbreaks in Relation to Fruit Growing.* Bulletin of Agricultural Experiment Station Cornell University pamphlet pp. 16.

Another example of the excellent work being done by the Cornell Agricultural College.

— *Proceedings of the Society of Arts, Massachusetts Institute of Technology*, 27th year, 1888-9, 8vo. pp. 135.

The report contains several good papers, among the best of which are the first and last, Prof. LANZA'S paper of "Steam Heating of Cars" and Prof. SHAPLEIGH'S paper "On Gas Lighting by Incandescent," chiefly, by the Welsbach mantle system, which shows very remarkable economy.

—*Interstate Commerce Commission.*—Construction of the Act to Regulate Commerce as it relates to the compulsory production under *subpœnas duces tecum* of books, tariffs, contracts, and papers for the purposes of evidence, and the duties of carriers engaged in interstate commerce in giving information shown by their books concerning rates, facilities furnished, and general movements of freight to parties interested in such matters and applying for such information in good faith. Pamphlet, 34 pp.

In this pamphlet the Commission lays down some excellent rules regarding the forcible production of original books and papers in proceedings before the Commission. It is very plainly stated that the call for a process to compel the production of private books and documents must be proved to be necessary. Witnesses or parties in interest must not be put to the expense of producing original records unless such records are really to be used. The Report refers to the readiness with which carriers have voluntarily produced their books, and says also: "We have seen cases where carriers were required by complainants to bring their books from points hundreds of miles distant from the place of hearing, and when thus produced they were not even opened by those at whose earnest call they were brought."

—*Cable Railways*, an article by CHAS. W. HASTINGS, in the *Providence Sunday Journal*, Sept. 1, 1889.

We noted recently in this column an interesting paper on "Irrigation" in the San Francisco *Daily Chronicle* of August 23, as a grateful departure from the usual treatment of technical subjects by the daily press. We are now glad to compliment an Eastern paper, the *Providence Journal*, on a similar bit of enterprise. The issue of Sunday, Sept. 1, contains a page article describing the cable railway system of street transportation; and there are more facts of interest concerning cable railways condensed in this space than we remember to have seen anywhere in similar compact form. The article is illustrated by 16 engravings showing various details of construction, most of them taken from Kansas City practice. The article contains some very interesting statistics of the cost of construction, operation, maintenance, and the growth of traffic. It is written in a very clear and interesting style and does its author much credit. For the benefit of any of our readers who may wish to see this article we have procured a few extra copies of the paper, and will send one to any address on receipt of 15 cents.

—*Transactions of the Canadian Society of Civil Engineers*, Vol. III. Part 1, January to June, 1889. 8vo. pp 245, with portrait of SAMUEL KEEFER, President, and 11 plates.

The principal papers are DENIKL on the "Panama Canal," FINDLAY on "Cantilever Bridges," VERNON SMITH on the "Development of the Locomotive," BARNETT on "Design and Construction of Workshops," BURCHELL on the "St. Johns Dry Dock" (we will republish it in our issue of next week as it gives the most complete data yet published on the construction of these docks); BENNETT on the "Esquimalt (B. C.) Stone Dry-Dock," and TUPLIN on "Locomotive Construction." All these papers seem to be of permanent value and highly creditable to this young society.

—*Air: Its Uses and Abuses.* How perfect ventilation can be secured under all circumstances. Gouge Heating & Ventilating Co., New York. Pamphlet, pp. 36.

An exposition of the Gouge system of ventilating houses, etc., by induction.

—*Proceedings Institution of Civil Engineers*, Vol. XCVII pp. 525. Contains papers on "Alternate Current Machinery," KAPP; "Indian Railways, Broad and Narrow Gauge Contrasted," WARING; "District Distribution of Steam, U. S.," EMERY; with abstracts of papers on Tides near Portsmouth, Ice-Breaking Steamers, Steel Dock Gates, Perforated Cake Powder, Water Softening Apparatus for Locomotives, Removal of Rock Under Water without Explosives, Movements of Sewer Air, etc.

One of these papers, on "Removal of Rock Under Water without Explosives," seems especially important relating to the actual work of the percussion dredges illustrated by us Jan. 26, 1889, and we abstract it fully.

—*A Popular Treatise on the Winds*, comprising General Motions of the Atmosphere, Monsoons, Cyclones, Tornadoes, Waterspouts, Hail-Storms, etc. etc. By WM. FERREL. M. A. Ph. D., Late Professor and Assistant in the U. S. Signal Service, etc. 8vo. pp. 505. New York, John Wiley & Sons, $4.00. Good Index.

This work is an expansion of a series of 40 lectures delivered by the author to a class of army officers of the Signal Service in 1886. It may be briefly described as a treatise on the mechanics of meteorology, and we take it to be, beyond question, one of the best books on the subject in our language. There are numerous parts of it which engineers concerned as to meteorological phenomena (and what engineer is not?) would find it highly profitable to study.

—*Naval Mobilization and Improvement in Material*, Information from Abroad, June, 1889. Pub. Doc. Navy Dept. 8vo. pp. 485, many plates and tables. Lieut. R. P. RODGERS, Chief Intelligence Officer.

This is one of the most elaborate and creditable volumes of the "Information from Abroad" series which the Government has issued. We regret that the interest of our readers in purely military matters does not warrant us in making the full review which its value warrants. Such publications are certainly one of the cheapest possible ways of keeping our naval officers fully informed of the progress other nations are making.

—*Report of the New York Produce Exchange*, July 1, 1887, to July 1, 1888. THOS. P. WHITE, Secretary. 8vo, pp. 136.

Contains very elaborate produce statistics.

—*Proceedings of the United States Naval Institute*, Vol. XV. No. 2.

Contains papers on "Naval Defence of the Coast," 'Collisions at Sea.' "Right of Way at Sea," Domestic Steel for Naval Purposes," "Efficiency of Oil for Subduing Waves," etc. etc.

— *Gearing.* Catalogue of Robert Poole & Son Co. Engineers and Founders, Baltimore Md. 12 mo. flex. leather, pp. 170.

A model of careful preparation, chiefly occupied with tabular details of the great variety of gearing manufactured by the company.

— *Intelligence Report of the Panama Canal.* By Lieut. CHAS. C. ROGERS, U. S. N. Pub. Doc. 1889, 8vo. pamphlet pp. 57, with map and 25 photo-type views.

As this Intelligence report extends only to March 1887, it has ceased to have any great value except as a record of ancient history. The views and map make it of permanent value.

— *A Treatise on Masonry Construction.* By IRA O. BAKER, C. E. Prof. C. E. University of Illinois, 8vo. pp. 551, 160 cuts, 6 plates, fair index. New York, John Wiley & Sons, $5.00.

We think we are fully justified in describing this as by far the best practical treatise on modern masonry practice in existence. It is certainly a most valuable work. As we shall shortly review the book at length we will not now attempt to describe it more fully.

— *Catalogue of the A. A. Griffing Iron Co.* Jersey City N. J. Small 4to. pp. 108.

A neat presentation of an admittedly excellent (Bundy radiator) system of heating giving price lists and full details.

— *Carolina Oil & Creosote Co.* Carbonizing and Wood Creosoting Process for Preserving Wood. Wilmington, N. C. 8vo. pp. 17.

A brief but clear and apparently fair exhibit of the theory and practice of this process, which we need not say is the most approved for most uses.

—*Report of the Twenty-second Annual Convention* of the American Railway Master Mechanics' Association. Held at Niagara Falls, June 18-20, 1889. ANGUS SINCLAIR Secy., 8 vo. pp. 20.

This is a somewhat unusually thin report, especially in being almost destitute of illustrations. Nevertheless it contains, as usual, many reports of permanent value, abstracts of which we gave when they were presented.

— *Illustrated Catalogue of James B. Clow & Son, Chicago.* Large 8vo. pp. 461, 1,278 cuts.

It will sufficiently indicate the range of supplies for plumbers, steam and gas fitters, water and gas works, etc., included in this sizable and handsome volume to say that the index of articles listed in it covers five pages in small type. While not the largest of such publications, it is one of the largest and handsomest, and a very convenient work of reference.

— *Reference Book of Interlocking and Signaling Devices and Posts used in Connection Therewith.* As manufactured by the Union Switch and Signal Co., Swissvale, Va. Oblong 12mo. flex. leather, pp. 365.

It sufficiently characterizes this handsome "Pocket Reference Book" (it is rather large for the pocket) that although a trade publication, and largely prepared for convenience of ordering, it is unquestionably the most complete source of information on modern signalling, interlocking, and other safety appliances to be had in print. As such, we propose making some extracts from its pages, and shall hope to review its more interesting features more fully later.

— *Modern Electricity*, with Glossary of Electrical Terms. By THOS. KIRWIN. Pamphlet 12mo. pp. 128. Boston: De Wolfe, Fiske & Co. 30 cts.

A light and sketchy popular account of modern electrical science, of no special scientific value, but convenient for those hungering for thirty cents' worth of knowledge on the subject.

— *Durham System of House Drainage*, 1889. Durham House Drainage Co., New York. Small illustrated pamphlet of 33 pages.

— *Catalogue and Descriptive Manual of Mathematical Instruments and Material.* G. L. WOOLMAN, New York.

SOCIETY PROCEEDINGS.

American Gaslight Association. — CHARLES H. NETTLETON, Birmingham, Conn.; EDW. LINDSLEY, Cleveland, O.; D. H. GIGGIE, Quebec, Canada; GEO. S. HOOKEY, Augusta, Ga.; and E. G. COWDERY, Milwaukee, Wis., have been appointed a committee to nominate officers at the approaching session of the American Gaslight Association in Baltimore. The Association will meet Oct. 16, 17 and 18.

American Society of Civil Engineers.—At the meeting on Oct. 2, Vice-President A. FTELEY, in the chair, Mr. FREEMAN read an abstract of a valuable paper on "The Hydraulics of Fire Streams."

The four resolutions for the appointment of committees on water supply, standard rail sections, uniform methods of testing material for metallic structures, and requirements for these materials which would conduce to further improve the grade of such structures, were all carried.

The following candidates were declared elected:

MEMBERS.

WM. A. AIKEN, Gen. Man., Mt. Vernon Bridge Co., Mt. Vernon, O.

WARD BALDWIN, Prin. Asst. Eng., Cin., N. O. & Tex. Pac. Ry., Cincinnati, O.

SUMNER H. BODFISH, U. S. Geological Survey, Washington, D. C.

BERNARD R. GREEN, Supt. and Eng. of Congressional Library, Washington, D. C.

ELLIS B. NOYES, Asst. Eng. Champlain Canal, Fort Edward, N. Y.

CHAS. O. PARKER, Chf. Eng., Central R. R. & Banking Co., Macon, Ga.

JOHN C. PATTERSON, Asst. Chf. Eng., Poughkeepsie Bridge and connections, Poughkeepsie, N. Y.

OLAF R. PIHL, Asst. Eng. at Cascade Locks, Oregon.

ANDERSON H. TYSON, Reading, Pa.

ALVA M. VAN AUKEN, Denver, Col.

JUNIORS.

FREDERICK ROSENBERG, Supervisor, Div. A, Pennsylvania R. R., Jersey City, N. J.

WM. W. SEITZINGER, Asst. Eng. with Brown, Howard & Co., Tarrytown, N. Y.

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GEO. H. FROST . . . . . BUSINESS MANAGER

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Coming Technical Meetings.

Association of North American Railroad Superintendents.—Next meeting at the Hotel Brunswick, New York, Oct. 7. Secy., C. A. Hammond, 350 Atlantic Ave., Boston, Mass.

Engineers' Club of Kansas City, Mo.—Next meeting, Oct. 7. "Tests and Observations on Building Stones," J. A. L. Waddell and W. D. Jenkins. Secy., Kenneth Allen, 310 Baird Building.

New England Railroad Club. Boston, Mass.—Next monthly meeting, Oct. 9. "Permanent Way and Rolling Stock, and their Relation to Each Other." Secy., F. M. Curtis, Old Colony R. R. Co.

American Forestry Congress.—Annual convention at Philadelphia, Pa., Oct. 15 to 18. Secy., J. B. Harrison, Franklin Falls, N. H.

Boston Society of Civil Engineers.—Next meeting, Oct. 16. Secy., S. E. Tinkham, City Hall.

American Society of Civil Engineers, New York.—Next meeting, Oct. 16. Secy., John Bogart, 127 E. 23d St.

THERE are few publications reaching this office which we receive with more pleasure than the annual Track Inspection Report of the Savannah, Florida & Western Railway system. We believe thoroughly in such a system of inspection as the only mode of maintaining a proper *esprit* among the lower maintenance-of-way officers. Theirs is a most monotonous task, and in a sense an inglorious one, since considerable negligence is possible without its appearing on the surface, while there is little stimulus to special exertion in the ordinary routine of track work. Some system of annual track inspection would be universal if officers properly appreciated its stimulating effect; but this requires a somewhat intimate familiarity with track details and trackmen, and a somewhat irksome annual trip at freight speed over the road as well. Accordingly, while many roads have at various times tried the system, there are few which have persistently kept it up. On the S. F. & W. system a few hundred dollars annually are distributed in track premiums, not enough to be seriously felt as an item of expense, but quite enough to add a little keenness to the pleasure with which an "honorable mention" is received.

THE awards on this road are: For the best and second-best division, $100 and $50; for the best and second best section on each division, $40 and $20; for the neatest section house and grounds, $10 to the section-foreman's wife, or to the foreman, if single; for the section on each division showing most improvement, $15; for the section on each division operated with least labor per mile of track (with limitations as to condition of track) $10; for the section on each division showing least expense for tools per man, $10. The marking is done by a committee of two or three on each of six details, 10 indicating perfection. If we may believe that the standard has been kept uniform for the past four or five years, the steady progress toward perfection shown in the following tables is certainly a good recommendation for the system; and surely it needs no demonstration that such a system must greatly stimulate the foremen to use the labor and materials apportioned to them to the best possible advantage.

Total Averages of Annual Inspections.

Charleston & Savannah Ry.

Year	Line	Surface	Level	Frogs and Switch	Drainage	Policing	To'l av. per mile.
1884	Not given						7.740
1885							7.850
1886							7.510
1887	8.14	8.03	8.14	7.18	8.39	5.06	7.610
1888	8.60	8.73	8.62	8.65	8.48	7.58	8.42

Savannah, Florida & Western Ry.

1884	8.63	8.02	6.72	8.99	7.70	7.68	7.950
1885	8.43	6.88	7.10	8.63	6.31	8.10	7.601
1886	8.46	8.47	7.43	7.87	8.17	7.66	8.083
1887	8.21	7.68	8.04	8.17	8.14	7.78	7.956
1888	8.80	8.84	8.29	8.36	8.34	8.88	8.64

Brunswick & Western Railroad.

1888	6.10	6.49	6.42	7.17	6.63	6.75	7.06

IN commenting upon the usually bad condition of common roads in Louisiana, and the practical failure of that State to enforce a law made in 1878 to utilize convict labor on country roads, the New Orleans *Times-Democrat* arrives at the sensible conclusion that it costs money to secure good roads and keep them in repair; and the sooner the people of a State fully realize this truth the sooner will the road question be settled. Convict labor, as Louisiana and other Southern States have used it, makes necessary a multitude of guards and the maintenance of guards and convicts; and this expense, coupled with inefficient labor, makes the law practically inoperative. Tennessee has solved the problem in a much more satisfactory manner by building turnpikes and collecting toll from them until the roads are paid for. And these turnpikes were built by contract under skilled supervision and are among the best in this country. The Tennessee plan is a good one, cutting out much tedious legislation, and is an excellent plan for a beginning at least,—one that might be followed in many other sections with advantage.

THREE successive accidents within a week, each less excusable than the preceding one, have again shown what long since ceased to need proof, that even the best of employes will at times do just the wrong thing at the wrong time; and hence that higher officers who persist in trusting wholly to human vigilance, without necessity, and seem to feel that they advance a sufficient excuse when they say that "the accident was wholly due to the carelessness of" this or that unfortunate subordinate, are themselves the ones truly to blame for the disasters sure to follow.

The first of these accidents happened Sept. 21 on a part of the Boston & Maine system, at South Lancaster. It was not an especially serious accident,—only 1 killed and 2 injured,—but is notable as one of the many cases in which concurrent carelessness by two employes (not to say three) alone made disaster possible. A night operator fell asleep. A freight train passed, the conductor being bound to register at this station, and being liable to receive orders there. He saw the operator asleep, registered, asked no questions and did not waken him, and went off with his train. A moment later the operator awoke, lied in response to a question why he had not answered before by saying that his instrument had been out of order, and to the question if the aforesaid train had passed answered No at a guess. He then took an order to hold that train, and another train, a "wildcat,"—a species of train which light traffic roads like this use far too much, and far more than roads of heavier traffic,—was ordered forward to meet it. The combination of negligence of both operator and conductor, with unusual weather and an unusual train, alone made this accident possible.

THE second of these accidents happened within the city limits of Chicago, Sept. 24, costing 6 lives and 13 injuries. It appears to have been wholly due to nepotism on the part of Master Mechanic TWOMBLY of the C. R. I. & P. Ry., he being alleged to have retained as a locomotive runner, in spite of repeated prior offences, a son addicted to drink. The most salient moral in this case, of course, is the absolute necessity of prohibiting the use of liquor by locomotive runners; but it is also a fact that the soberest and best men will sometimes run as this man did, ahead of time, and that if there be nothing but the watch in his pocket to warn him of his error, there will be, as there always have been, instances in which accident will result therefrom.

THE third of these accidents was the most excusable of all as respects the employes, but the least excusable of all as respects the management. It happened on the New York Central Railroad at Palatine Bridge, at midnight on Sept. 27. Two sections of a fast vestibule express were running in accordance with a regular system, separated only by an interval of ten minutes *of time*. The engine of the first section broke down between stations, so that a cylinder was disabled, and with one cylinder only, of course the train rapidly lost time. The engineer ought, of course, to have taken no chances, but to have stopped immediately and sent back signals; so that in a sense it is true that "the accident was wholly due to a mistake in judgment on the part of the engineer and conductor"; but who that knows the stringency with which "making time" is insisted on for these trains, and necessarily, can blame the engineer for hesitating to lose the ten minutes extra which this would have required, and for hoping, and acting on the hope, that he might succeed in reaching the next station ahead? At any rate, it is a kind of chance which good and cautious men will continue to take in sudden emergencies, to the end of time, if it is left to their discretion to protect themselves.

THE true and only remedy for all such disasters is to be found in a block system, which ensures an interval of space behind a train, and so protects the train even if the vigilance of the train crews fails. This system is not available universally, it may be admitted, because it is too expensive for roads of light traffic; but it has been for a decade or two in all but universal use in England, a substitute known as the train staff system being in use on lines of very thin traffic. As to precisely what point of traffic it becomes reasonable that a road shall use the block system, there is ground for honest difference of opinion; but there is no room for doubt that the road with the heaviest traffic on this continent

ought to use it, and would find the cost per train so small that it would almost if not quite pay for itself directly, besides the saving of human life in such accidents as these. It is true, and it should not be forgotten, that the absolute block system itself in its original form does not entirely eliminate danger from human carelessness, as was illustrated by the "Meadows" accident on the Pennsylvania Railroad, just out of Jersey City, three or four years ago. It will occasionally happen that the signal operator in the tower will pull the signal to open the block when he has right before him the evidence that he ought not to; and for this reason we have always looked on the various automatic block-signalling apparatus, electric or pneumatic, as preferable in type, and as quite certain to prevail in the end over the tower-operator system. That this is so is strongly indicated by the tact that 385 miles of track in New England alone are already protected by one of these electric systems—a system which experience has shown to be of conspicuous merit. But while it is pardonable that there should be difference of views as to what system is best, that no system at all should be in use on our road of heaviest traffic ought to be regarded as unpardonable.

THE honors lavished by European nations upon THOMAS EDISON, "*le grand inventeur Américain*," should cause his fellow-countrymen to blush for their comparative dearth of public and personal appreciation of his wonderful achievements. Frenchmen have been particularly gracious in their attentions, and by every means in their power have expressed their appreciation of his works. Mr. EDISON, like most great inventors, is not a maker of after dinner speeches, nor happy in answering public congratulatory addresses. But, as Mr. WHITELAW REID said in replying for Mr. EDISON at one of the Paris banquets, "the man who has supplied the means for talking over leagues of space, and has preserved for eternity the human voice in his marvelous phonograph, has no need to be eloquent: his works talk for him."

Americans have no decorations to confer upon even the greatest inventors; but they still might find methods of publicly recognizing the man himself, as well as the children of his busy brain. We do honor our soldiers; but the workers in the peaceful field of industry, the men whose inventions become a necessity to us, and at the time revolutionize our daily life, must expect only eulogies and monuments; and even that tardy recognition is not always accorded them. Our scientists and the nation generally, profiting by the brain-work of a man of the EDISON type, might with profit and honor take a leaf from the book of our European cousins in matters of this kind.

Exposition Buildings: A Chance for Originality.

Since our last issue the Site Committee has receded from its previous position that part of Central Park should be used for exposition buildings, by a resolution printed elsewhere and it now recommends that the buildings be confined to Morningside and Riverside Parks, the land between them and between 108th and 116th Sts. (which includes nearly half of the Bloomingdale lot), and the block of 62 acres north of Central Park between 110th and 113th Sts. This tract, neglecting the extremities of Riverside Park, is some 300 acres in area, in addition to which the committee still recommend—probably to let themselves down easy, for no one is likely to take the suggestion seriously—that the northern part of Central Park be fenced in as part of the grounds, "to afford amplitude and means of refreshment and repose without surrendering the right of admission."

So far as "amplitude" is concerned, that is the one thing to be avoided if possible. There will be enough of it at best. As for the vague phrase "refreshment and repose," whatever may be the real meaning intended by it, there is not the least probability that Central Park can afford either effectively, or that it would be yielded for the purpose if it could. A man seeking "repose," after doing the Exposition for an hour or two, has little disposition to walk a mile after it. He wants it on the spot if at all, and if possible without leaving the building. If he wishes "refreshment," whether solid or liquid, he is but little more likely to care to walk far after it. Small and numerous buildings or apartments in the immediate vicinity of the great buildings are what is needed, and for these is ample room in the included area of 300 acres or so, after allowing for 75 acres of exposition buildings. The committee would have acted far more wisely had they frankly admitted their mistake, and dropped Central Park from consideration altogether.

The committee itself confesses in its resolutions, moreover, that it will be practically impossible for them to secure any large part of this area except by lease at fair market prices, and that for some considerable part of it the only feasible method will be by condemnation under right of eminent domain, "by and in behalf of the city."

Can land for such uses be condemned in this way? The committee plainly think so, or they would not advise it; but it is at least open to question, and there is sure to be a determined legal fight and long delay, before land owned by individuals will be surrendered on compulsion. Moreover, in proposing to take such valuable private property as this for such a purpose, the committee are making an experiment which at least has never yet been tried, whether it be a wise or foolish one. Since the great London World's Fair of 1851, the first thrown open to the world, eight international exhibitions have been held, as follows:

City	Year.	No. of Exhibitors.	No. of Visitors.	Cost.	Acres under roof.
London	1851	17,000	6,039,195	$ 1,460,000	21
Paris	1855	21,779	5,162,330	5,000,000	24¼
London	1862	28,653	6,211,103	2,300,000	23
Paris	1867	50,226	10,000,200	4,000,000	37
Vienna	1873	42,584	7,254,687	11,000,000	40
Philadelphia	1876	60,000	9,857,625	8,000,000	60
Paris	1878	60,000	16,226,742	9,000,000	—
New Orleans	1884	90,000	3,000,000	————	80
Paris	1889	100,000	*35,000,000	$10,000,000	49½ +

*Estimated, from rate of attendance to date, which is somewhat over double the attendance in 1878.

[The area given for the present Paris Exposition includes only the main buildings in the Champs de Mars. There are some 15 acres or more of minor buildings in addition, and at Philadelphia also there were 10 acres of such minor buildings under roof in addition to that given.]

Every one of these prior exhibitions has been held on land belonging to the public, or what was practically such. Can the finances of such a Fair be safely burdened with the great cost of even renting land in this locality, in addition to the $6,500,000 worth of buildings which are all practically thrown away, after the Fair is over? By referring to the map and article on "The Metropolitan Development of New York," which appeared in our issue of March 17, 1888, it will be seen that the choice lands which it is proposed to take for the Fair have an assessed valuation of $50,000,000 or over per square mile, and an actual valuation of nearly double that. Keeping in view all the contingencies of condemnation, and allowing that considerable land will be leased at nominal rates, the actual cost of the land is likely to be $15,000,000 at least for say 200 acres of privately owned land, or a rental equivalent to that valuation, say $750,000 per year for four years, or a total of $3,000,000.

This is an enormous addition to the items of cost of past fairs, which have been heavy enough and it leads us to believe that, whatever the site chosen for the buildings, it should be carefully considered, now while there is yet time, whether economy, public convenience, and impressiveness of effect alike will not be best subserved by one large building in stories, say a 20-acre building with 100 to 120 acres of floor space, rather than by an immense area of detached one-story buildings.

So far as economy is concerned, there can be no doubt of this. Apart from the large saving in land just noted, the great expense of such buildings is for the roof and foundations. Lifting the roof of one of these 20-acre exposition buildings up a little higher, so as to make two stories instead of one, only adds to it the bare cost of the floor and sides; and similarly if two or three or four additional stories be added. The cost of floor space per acre is thus greatly decreased, the machinery and other very heavy exhibits, of course, being accommodated on the ground floor, so that no excessively massive floors are needed.

So far as exterior effect is concerned, there can be still less doubt. No art can give exterior diginity and impressiveness to a building 25 acres in area and only one story in height. It loses even the grandeur of mere mass, and looks to the eye inevitably like what it is, a mere long-drawn-out shed. A single vast exposition building in stories, 200 to 300 ft. high, would be vastly more impressive exteriorly than half a dozen 20 acre buildings giving the same floor area. Moreover, with such a building a large square tower 600 to 700 ft. high can be combined as an architectural feature. With the one-story buildings, any feature of this kind in combination with them would be absurd, and accordingly the tower has to be made a feature of itself, discordant rather than otherwise with the other exposition structures, and noticeable for its height alone, instead of as a part of a great whole, while really affording no better view, as we showed last week, than one of half the height, which would also serve an architectural purpose.

So far as interior effect is concerned, we believe that in this, likewise, the building in stories would have the advantage. The grand effect which comes from being able to see the entire area of the roof at once, from any part of the interior, would be lost; but in the end this very spaciousness becomes a burden of the flesh, and loses its effect on the imagination because the visitor has it everywhere with him, while for the same reason it is positively depressing to the spirits. The shrewd tradesman who wishes to display fine goods to particular advantage shows them in separate small rooms, and not in one great room. Every visitor to the Art Annex at the Philadelphia Centennial can remember what a relief the separate small rooms of that annex were to the wearied mind and body, creating the comforting illusion that here at least there need be no haste, for there was not much to "do." It is our belief that if four-fifths of the Exposition were in comparatively low and small galleries and apartments, the comfort of visitors and the effect of the exhibits would be greatly heightened, while the impressiveness of the grand central effects, showing the full dimensions of the building, would be greater both absolutely and by contrast. In a word, spaciousness and immensity should not be at all points the predominating

effect of the interior, but should rather be carefully avoided, except in some central spaces, for many reasons.

So far as convenience of access to and from the various parts of the Exposition is concerned, we believe it would prove in every way better to have the separate buildings piled on top of each other in stories rather than spread out horizontally, with "magnificent distances" between them. In fact, we regard this convenience of access as one of the chief advantages of a single great building in stories. Every one who visited the Philadelphia Centennial will remember what a weary task it was to get from building to building, or even from one part of a building to another, despite all the aid to be had from internal railways. On the ground laid out for the New York Exposition this will be still more the case, both because the area is greater and because ground is more broken.

The present Paris Exposition is distinctly ahead of that of Philadelphia in this respect, from the very fact that it occupies less ground. One of the most intelligent and vivid accounts of the Exposition thus speaks of this point:

> The next feature of the Exposition that strikes a thoughtful visitor as a great factor in making it so popular is its compactness. The enormous aggregation of palaces, booths, gardens, sheds, promenades, restaurants, and all other constructions is confined within a space of 173 acres. A New Yorker can fix this in his mind's eye by recollecting that it is about the same space as Riverside Park takes up. In fact, Riverside Park is 4 acres bigger than the ground in use in the Paris World's Fair
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> The Paris grounds, therefore, are a little more than one-fifth the size of Central Park. The American who went to the Philadelphia Exposition and then to the one in Paris this year appreciates how much advantage there is in compactness, for the Philadelphia Exposition covered 63 acres [112 acres, or 285 acres in all.—ED.] more than this in Paris. To see the show of 1876 was to indulge in a series of long, hot walks from building to building, so meagre and scattered was the display and so great the area it was built upon. In Paris the objects of interest are close together, and whenever there is a necessity to walk, the journey is made beside gardens and fountains upon promenades covered with canvas, or under the roofs of the sheds or buildings.
>
> And, by the way, that is the fourth good point about the Parisian exhibition. It is not merely interesting: it is pleasant, comfortable—or as nearly so as one of these enormous exhibitions can be made. There are no vast fields of grass, or long unshaded walks like those in Philadelphia, which make a memory of that show like a recollection of Hades. Scattered all about are little beds of grass or of flowers, pools of water, fountains or cascades, great pieces of statuary, and glimpses of, or walks beside, the cooling Seine.

Now, as every one is seeking for some distinctively novel and American feature for the Fair, why not find it in the most distinctive of all American contributions to modern engineering plant, the passenger elevator or "lift"? Europe as yet knows hardly anything of the real capabilities of the American elevator; few Americans even fully realize it. Allowing for three times the Philadelphia totals (viz., 274,919 visitors on heaviest day, 115,315 highest daily average of a month, and 9,910,966 total admissions), there need be no doubt whatever that an ample elevator plant to handle all this great crowd with ease can be disposed about a single large building in such manner as to make ascent or descent easy from any point at all ordinary times, and yet not occupy much valuable floor space or be obtrusively conspicuous. All our elevator builders would compete sharply for the privilege of furnishing this plant at very low cost, entering it as an exhibit, and it would, in fact, be one of the most interesting and significant exhibits in the whole exhibition. It would be talked of all the world over quite as much as the Eiffel tower has been, and be regarded as an even more creditable novelty, especially if the other suggestion were adopted, of a *broad and spacious* tower, not so enormously high, but in successive stories, with ample room in its upper stories for restaurants and other resting places, and with such ample elevator service that a man could ascend it in three minutes instead of losing the three hours which it takes to ascend the Eiffel tower.

Would not this be a better mode of gaining room for "refreshment and repose" than making an annex of Central Park? A man who got tired of doing any part of the exhibition could then simply step into an elevator and reach some other part, or go still higher and find his "rest and refreshment" at once, while the money which it will cost to make a mere vulgar enlargement of the Eiffel tower, 1,320 or 1,492 ft. high, will enable a tower 660 ft. high to be made very spacious indeed and in successive stories, giving chance for "refreshment and repose" to 12,000 to 20,000 people at once, as any one will see by making a brief calculation, assuming such proportions as he thinks would be effective.

It is said that 40,000 a day enter the Equitable Life Insurance Building in this city, and these are all handled practically without delay to any one at any time, by ten rather small elevators, taking about two minutes per trip, and stopping at numberless floors. In an exposition building, the elevators would naturally be made rather large, to hold 25 or 30 persons each when full, and with separate doors for entrance and exit, so that the two processes could go on simultaneously. Such an elevator would make a round trip in a six-story exposition building not over 250 ft. high in 2½ minutes at most, or say 25 trips per hour. It would, therefore, in a "rush" hour handle 600 to 750 persons easily in one direction: and 240 such elevators scattered about the building would handle 150,000 to 180,000 people in one rush hour, which ought to be enough for all requirements. If not, it could be readily increased to any desired limit; and this plant, after the Exposition was over, could be removed, and sold for other uses.

From every point of view, therefore, a single many-storied building, with a "tall tower" as a part thereof (which would make it by far the highest *building* ever erected by man, in spite of the Eiffel tower), seems to offer great advantages.

On whatever spot the exhibition may be held, we earnestly hope that this possibility will be thoroughly investigated, and comparative designs invited from architects. Such a building would be absolutely unique—the novelty which is so justly and earnestly sought for. If designed by an architect of genius, and built almost wholly of glass and iron, its effect would be overwhelmingly grand and impressive, and by night it would be like a bit of fairy land,—a sight such as the eye of man never rested on before and worth crossing the ocean to see, especially if it face on the water, so as to give all the added charm of an unobstructed view from a distance.

This will be the tenth successive world's fair. On whatever spot it is located, it is surely worth while to try at least to utilize and illustrate modern progress in three of its most striking features, elevators, iron floor construction, and electric lighting, rather than to content ourselves with slavishly copying on a bigger scale the exhibition buildings of the past, in the vain and foolish hope that by making our buildings bigger and our towers taller we shall be regarded as outdoing all previous shows. Not thus is interest created or honor won. The Eiffel tower is something new in type, a fine conception finely carried out. Therefore it draws. It is our firm conviction that a mere appropriation and expansion of the conception on this side of the water, will not prove to have any drawing power at all. The judicious will grieve or laugh at it, as a proof of mental poverty rather than of our science and skill. The unskilful will follow their lead here, as they do in Paris, but in the opposite direction. We ought to be, and we soon all should be, ashamed rather than proud of it; and who finds pleasure in throwing himself in the way of anything of which he has just cause to be ashamed?

Let us do something NEW, distinctly illustrative of modern progress, while we have the chance. The next chance will not be ours, but some other people's, and they will avail of it to our shame if we do not.

CORRESPONDENCE.

The Theory of Transverse Strength.

AUSTIN, Texas, Sept. 7, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

In your issue of Aug. 10, 1889, you dismiss in an offhand way any discussion of the theory of the transverse strength of materials proposed by me in my work on "The Strength of Beams and Columns," simply because the deductions, from considering the axis or centre of motion to be at a point on the outside of the beam, contradicted the deductions from considering it at a point within the beam or on the neutral line; and for my guidance and information you kindly refer me to certain communications contained in previous issues of your journal.

The correctness of the deductions referred to, from problems *in pure statics*, are unquestioned, and the sophistry of the reasoning is in applying them to the *transverse* strength of materials, or rather the lack of argument to show that they do apply as applied, for it is *gratuitously assumed*. This I will show, with all due respect to the eminent names over which the communications appear.

As the article of Prof. A. J. DuBois in your issue of Jan. 21, 1888, is more responsive to the question, I will consider it alone. He says:

"If any number of *forces* hold a body in equilibrium, three conditions must always be simultaneously fulfilled. (1) The forces must balance horizontally. (2) They must balance vertically. (3) The moments must be equal about any point. If the first only is fulfilled, the body will move up or down, and at the same time revolve. If the first and second only are fulfilled, the body will revolve. If none are fulfilled, the body will revolve until the resultants are in the same straight line, and it will then *travel* in the direction of the greater force."

Here our writer suddenly stops in his list of calamitous consequences that will result to the beam from our failure to observe the three conditions of equilibrium. I will extend the list a little. If the second and third only are fulfilled, or if the *tensile* force is greater than the *compressive* force in *each* half of the beam (as he construes the first condition), these greater *tensile* forces will cause the *whole beam to move to the right and the left at the same time*, pull it from its supports, and each tensile force will then move off in *opposite directions, each* dragging the *whole* beam, the load, the supporting forces and the remainder of the horizontal forces, which includes a force that is equal in magnitude and opposite in direction to itself, and, like the "babbling brook" in poetry and song, will "go on forever." This is a legitimate consequence of the failure to fulfil the first condition, but our sense and the power and fitness of things in nature flatly contradict the fulfilment of this legitimate consequence. The horizontal forces, developed when a load bends a beam, die as soon as they are born, and become dead forces so far as they may have any ability to give motion to the beam. These forces result from the transverse motion of one end of the beam while the other remains *fixed*: they cannot therefore be the *givers* of motion.

The horizontal, compressive, and tensile strains *each* represents the destruction of the moving power of two opposite forces; and as these represent all of the horizontal forces, it is illogical and unscientific to apply a condition to prevent that motion that could not take place if we did not apply it, the only effect being to make the tensile *strain* equal to the compressive strain, neither of which could *move the beam* if it existed alone.

These conditions of equilibrium are true for a *free* body acting under *applied* forces, each force being capable of giving motion to the body. Each *pair* of equal and directly opposed forces may be left out of consideration as they are independently balanced, and do not affect in any degree any one of the three conditions given. The body is conceived to be without strain, rigid and infinitely strong, and simply the field of action of the applied forces. A beam under a trans-

verse load is not such a *free* body, for it is *forced* to rotate transversely around a *fixed fulcrum*, from the applied loads exceeding the *rigid* strength of the material, and thus *develops* the horizontal forces, that are not *applied* and are *incapable* of giving any motion to the beam. But even these principles, if literally applied, would produce no error. It is only when applied to the forces in *each half* of the beam, making the tensile equal to the compressive force, instead of applying it to *all* of the horizontal forces, as one half can have no horizontal motion without the other, that a serious error is made, or $T - T + C - C = 0$ instead of $C - T = 0$, in which C and T represent the resultants of the compressive and tensile forces in each half of the beam, taken with their proper sign.

The power of the load to bend and break the beam is represented by its *moment*; this must be resisted by the sum of the moments of the tensile and compressive forces in each half of the beam or of the strains into which they are converted. The advocates of the common theory make the moment of the applied load equal to the moment of a *stress* couple, that consists of a push along the compressed layers and an equal pull along the stretched layers. This is shown to be true by the following analysis, and we will substantially reproduce Fig. 4, of the article referred to.

Conceive one half of the beam that was supported at its middle on the fulcrum *f*, Fig. 1, to be removed, and to *prevent motion*, apply the couple $(-T, +C)$, the forces T and C to be exactly equal in magnitude and in the same direction as the *forces* that would be produced by the load if the half beam, that supported it, had not been removed. Then it is argued that to prevent horizontal motion we must make $C = T$, and as these forces *act together* to prevent rotation, they can only do so by *tending* to turn the beam around the point *n*, the neutral line. In any system of forces, when one set prevents the other from turning the body to which they are applied, there is an *actual* common centre of motion around which each set of forces would turn the body if the other was removed, with respect to which the forces have actual leverage, and, being in equilibrium with respect to one point, they cannot as a consequence rotate around another point. As the load L first existed and developed the horizontal forces, its action determines the centre of motion. By removing the couple $(-T + C)$ the half beam will and must rotate around *f*, as it is a *fixed* and *common* point between the beam, as a whole considered to be a line, and its fulcrum; and as our applied forces T and C cannot *create* any *new* conditions, it must simply prevent this motion of the half beam around *f*. Then

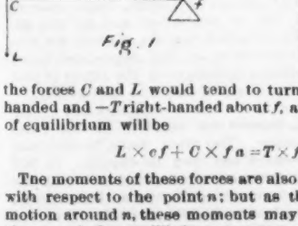

Fig. 1

the forces C and L would tend to turn the beam left-handed and $-T$ right-handed about *f*, and the equation of equilibrium will be

$$L \times ef + C \times fa = T \times fb$$

The moments of these forces are also in equilibrium with respect to the point *n*; but as there can be no motion around *n*, these moments may be called fictitious, and the equilibrium consequential, as it is a mathematical consequence that results from subtracting the same quantity from each number of the line equation of equilibrium, from which it is evident that the applied forces would not sustain the load as a couple.

In the *whole* beam the line *f g* is a fixed line, free from *tendency* to horizontal motion at any point. This fixed condition does not result from the equality of T and C but results from the line *f g* at each point being the change or *reverse* point in the line of direction of the opposing compressive and tensile forces in order that they may strain the material of the beam, and this line must be considered *fixed* from this condition, in the half beam. Now if we remove the load L, the forces $(-T + C)$ cannot move the half beam as they must not move the line *f g*. If $(-T + C)$ was a true *force couple*, this would of course be a mechanical absurdity, but in the whole beam they are simply strains that are incapable of giving any motion to the half beam. This lack of harmony between the *active* conditions in the whole beam and our *assumed* conditions in the half beam shows that there is a fallacy in our assumed conditions. From the above it will be evident the equilibrium of the half beam, Fig. 1, is not identical with that of the half beam it forms a part of the *whole* beam.

If we conceive $(-T + C)$, Fig. 1, to be *active moving forces*, then they represent the entire effect of the load L on the *system* of forces, that we conceived to be removed with the half beam. Then to make this load appear again we would duplicate its effect. From this it is evident that the half beam Fig. 1 is simply a beam *fixed* at one end and loaded at the other, and when the *rigid resistance* of the material is overcome from its *tendency* to rotate around *f*, the horizontal forces $-C$ and $+T$ will be developed, which, reacting against our *applied forces* $-T$ and $+C$, will produce strain in the material. As in the beam, these forces $-T, +T, +C$ and $-C$ are *simultaneously developed*. It is very

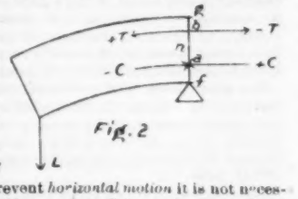

Fig. 2

evident that to prevent *horizontal motion* it is not necessary that C should be equal to T, for as long as $-T = T$ and $C = C$, these directly opposed equal forces will *prevent all motion* by *reacting* against each other; and as there is no mechanical necessity for our making $C = T$, to do so *arbitrarily* can only lead to erroneous results, as we have not yet discovered the correct mechanical relation that must exist between them. It can be shown by both theory and practice that the *pressures* C can have no leverage with respect to *n* in resisting the transverse motion of the load.

I will now give you a legitimate mechanical construction in which equilibrium will exist and at the *same* time contradict the 1st and 2d theories of internal stress as given by you in your issue of Aug. 10 which form the basis of the *common theory* of flexure. Let Fig. 3 represent two bent levers resting on the fulcrum *f*, and joined along the line *fg* in such manner that when the applied load L causes them to bend, the forces $-T + T + C$ and $-C$ will be developed, which reacting against each other become strains. The equation of equilibrium will be

$$L \times cf = C \times fa + T \times fb.$$

In this construction it is evident that as long as $T = T$ and $C = C$ and the moment of L is equal to the sum of the moments of C and T, there can be no motion of any kind in either lever. From the above equation it is evident that for any load L, there need be no fixed relation between C and T, and that it might be maintained with an infinite number of different values so long as these values made the sum of the moments equal to that of the load L. Either T or C might become zero, and the equation still show that equilibrium would

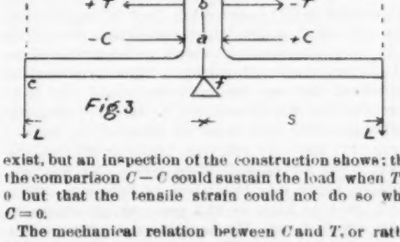

Fig. 3

exist, but an inspection of the construction shows; that the comparison $C - C$ could sustain the load when $T = 0$ but that the tensile strain could not do so when $C = 0$.

The mechanical relation between C and T, or rather that of their moments, results from the manner in which these strains are developed. The compression $(-C, +C)$ exists first, or sustains the load up to that amount that just overcomes the rigid resistance of the material; when this is exceeded, yielding horizontally begins, and deflection results and thus develops the tensile resistance. The moment of the tensile strain beginning at zero, continues to increase until some mechanical necessity stops it, which will be at its maximum value. This increase of the tensile moment necessitates, a movement of the neutral line from *g* towards *f*, the *direction* of this movement is fully confirmed by existing experiments. If space permitted me to lay the premises, in this communication, it could be shown that the limit to the increase in the moment of T is when it is equal to that of C, and the mechanical necessity for it. Now it is evident that if these *moments* are equal in the above equation, C cannot be equal to T.

Let $L = 10$ tons, $C = 300$ tons, $T = 120$ tons, $cf = 120$ ins., $fa = 2$ ins. and $fb = 5$ ins., then we have

$$10 \times 120 = 300 \times 2 + 120 \times 5$$
$$\text{or } 1200 = 600 + 600 = 1,200$$

The *moments* of T and C are *are equal*, in this example, but T is *not equal* to C, still we have genuine equilibrium; yet it is gravely asserted that to establish this equilibrium, without making $T = C$, will upset the science of mechanics. But the conclusions are not inconsistent with the established principles, and therefore there is no upsetting to be done.

Now if we conceive the levers to be filled with material as represented by the dotted lines in the figure and made homogeneous with them, we shall have a beam subjected to a transverse load and all of the conditions of its equilibrium. I think I have now shown the falsity of the fundamental principles of the *common theory*, and only by implication did I attack it. Its advocates claim correctly that "it gives nothing at all for *rupture*," while the theory proposed by me is for *strength*.

Had you examined the records with your usual care you would not have made the incorrect statement that an American author had in his second edition "expunged as erroneous" the statement contained in his first edition, that the moments of the forces on each side of the neutral axis are equal. It appears that this statement did not appear in his first edition (I have no copy to refer to) but did appear in the second and third, which I think is the last.

R. H. COUSINS.

[We wish to do all justice to Mr. COUSINS, and therefore give space to the above communication without by any means assenting to its statements or accepting its conclusions. We fail to see how his peculiar theory and method of argument is superior in clearness or simplicity, or in compliance with the conditions of actual practice, to the theory generally accepted. We recognize his right to disprove any scientific principle, however generally accepted, if he can do so by actual experiment or sound logic; but we do not see that he does this in the above article. His criticism of the lucid theorem of Prof. DUBOIS, which he quotes, seems nonsense; since, to produce his ludicrous consequences, he must have totally different conditions from those stated in the theorem. We also fail to see how it conduces to clearness in the theory of transverse strength to consider the fulcrum as an immovable point. As to his criticism of our statement regarding the "expunged paragraph," we have not the records at hand to verify our position, but still think that, as regards the author we referred to, our statement was correct. Unless Mr. COUSINS makes his theory of transverse strength more plain than that at present, we fear he will not gain many disciples.—ED. ENG. NEWS.]

Coal Consumption on the Manhattan Elevated Railway.

PHŒNIXVILLE, Pa., Sept. 27, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

Will you kindly advise me, if you have the information at hand, about what is the total efficiency of an elevated railroad locomotive, such as is used in New York? I mean the total percentage of power in the coal thrown into the fire-box, which is applied at the draw bar to pull the train. If you do not happen to have this information at hand, do not take any trouble to secure it. If you have it, however, I shall feel very much indebted to you for it. Very truly yours,

W. H. B.

[Our correspondent will find the information he desires very elaborately given in a paper by Mr. FRANK J. SPRAGUE before the Boston Society of Arts, 1886, the tabular summary of which, containing the pith of his investigations, is given as Table 173, on p. 559 of "The Economic Theory of the Location of Railways." The net result is that an engine burns 5,760 lbs. in nine round trips daily of 8.48 x 2 miles each, the engine being on duty 20 hours and having throttle open 6 hours. The total horse power developed per trip is 6,184 H. P. by 640 lbs. of coal, or 9.66 H. P. per lb. of coal; the coal burned per horse power hour being 6.21 lbs. This is not a very economical result upon its face. Locomotives under exceptionally favorable conditions burn only about half that amount of coal per H. P., hour; but here the engines are small, and the conditions under which they work excessively unfavorable for fuel economy. There are 26 stops in the 8.48 miles' run, so that the average speed is only 12.1 miles per hour, when the speed between stations is 19.2 miles per hour. Getting up speed to 19 2 miles an hour, 26 times is equivalent to lifting the train vertically $13.10 \times 26 = 340.6$ ft. in a run of 8.5 miles, or to 40 ft. per mile, whereas the total tractive resistance at that speed continuously maintained, taking it at 10 lbs. per ton (which is too high), is only some 26 ft. per mile.—ED. ENG. NEWS.]

That Turbine Problem Once More.

31 Milk St., BOSTON, Mass., Sept. 25, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

In your issue of Sept. 21, the criticism of Mr. M. J. BUTLER upon your solution of the turbine problem is treated in a manner which is hardly fair, and which might lead one to infer that the "hydraulic editor" had not returned from his vacation.

The problem was to find the net horse power that it was possible to obtain through a 20-in. pipe, and under 800 ft. head.

You cipher out a theoretical power of 44,840 H. P. and a net horse power of 32,000 H. P., a result so remarkable that by the *reductio ad absurdum* it should convince the computer who had a 20-in. pipe in view

that there was a misplaced switch somewhere in the line of logic.

Your assumptions practically give the energy of the discharge for a round-edged orifice 20 ins. in diameter, without a contraction, situated at the bottom of a large flume or reservoir 800 ft. deep, and discharging into free air: a "20-in. pipe" does not then enter as a condition. The head is all absorbed in producing discharge and transformed into momentum.

The problem itself was not so fully and clearly stated as to be strictly determinate, but, interpreting it upon any reasonable basis, Mr. BUTLER's exceptions all stand on a practical basis.

You say you "know of no such usual safe allowance as 4 ft. per second for flow in a turbine supply pipe or penstock, and do not believe such a rule exists."

That, even though the case proves an exception, there is such a generally recognized rule, we may best illustrate by saying that the undersigned has had occasion to directly or indirectly measure the velocity of flow in more than a hundred different turbine supply pipes planned by various engineers and builders, and so far as this experience goes, it illustrates that a mean velocity of about 4 ft. per second may be taken as fairly representing the maximum value adopted in the best practice in proportioning such structures to meet ordinary conditions; and for cases where a high degree of economy of power is desired, a mean velocity of only 3 ft. per second in the penstock will be found to best strike the balance between too great cost of conduit and too great loss by friction in the penstock. The question of maximum velocity allowable does not, as implied in previous discussion, rest upon considerations of safety, and is not bound to any one fixed figure, but hinges wholly on this adjustment of the balance between cost of pipe and value of the power to be sacrificed by use of a pipe which is small.

For such a head as 800 ft. we may assume that conditions are more like those of California or Nevada than of New England, and therefore refuse, as Mr. Butler does, to accept the limitation of velocity to 4 ft. per second for this case.

The problem was indefinitely stated. May we not take it as the question of a man desiring practical information, and assume, 1, That there is plenty of water to feed the 20-in. pipe, (It appears below that 65 cu. ft. per sec. will be necessary.) 2, That the mill site is not at foot of a precipice like the Yosemite, but that his 20-in. pipe must run down a slope, and is thus considerably longer than 800 ft. A knowledge of this length is essential to the solution of the problem. To illustrate method of solution we will assume slope 30° and length thus 1,600 ft. x 20 ins. diam. 3, He wishes to know the greatest power that can be got through this 20-in. pipe. For computing friction loss, probably the kind of pipe would be such that HAMILTON SMITH Jr.'s results of experiments on pipes in California would give the best degree of accuracy. These are not at hand at this writing, and by other data we compute the friction losses in the pipe for various mean velocities of flow (allowances for loss of head at entrance, etc., being omitted for simplicity in view of vagueness of data) as per table below, as the easiest way of finding the velocity giving maximum power. Thus we find that for

Mean velocity in pipe, ft. per second.	*Cubic ft. per second discharged.*	*Loss of head by friction in pipe, feet.*	*Effective head left for work, feet.*	*Energy of the issuing water, horse power.*
4	8.7	5.	795	781.
10	21.8	31.	769	1901.
20	43.6	124.	676	3342.
25	54.5	194.	606.	3674.
29	63.2	262.	538	3855.
30	65.4	280.	520	3826, max.
31	67.6	299.	501	3840
40	87.2	498.	302	2986
50	109.	772.	28+	346+
50.7	110.	800.	0	—

the length of pipe here assumed, a mean velocity of 30 ft. per second will develop the maximum of power, 280 ft. of head being absorbed by friction, and 520 remaining for work. If flow is more rapid, the loss due friction in pipe exceeds the gain due increased volume delivered. If length of pipe be greater, a less velocity would give the best results.

The discharge under conditions for maximum power is seen to be 65.4 cu. ft. per sec.

This volume would be discharged under the existing head by a nozzle about 8 in. in diameter, or no larger than some of the monitors used in hydraulic mining in California.

And if this were used on a reaction wheel giving 75 per cent. efficiency, the maximum net effective horse power through our 20-in. pipe would be 75 per cent. of 3856 = 2892.

Mr. BUTLER's remarks as to the practical difficulty of using a turbine water-wheel for such a high head by reason of the high circumferential velocity required, are well grounded and worthy of more consideration than you give them.

I think we may say that for any form of turbine used in America to obtain a circumferential velocity of buckets adapted to receive impact of jet under 500 to 800 ft. head, with the small loss of energy attained under ordinary heads, would require such a high number of revolutions per minute as to be impracticable; or conversely, in operating turbines of any ordinary form under great heads, the efficiency is very low, by reason of shock in impinging of jet upon buckets.

The great head is not of itself unmanageable. In southeastern France, in the foothills of the Alps, are very small turbines under even greater heads, and I recently saw in London a water motor, similar to a 3-cylinder Brotherhood engine, operating smoothly under 1,800-ft. head.

I should not, however, agree with Mr. BUTLER that a water-pressure engine of the type described in Weisbach is the motor best adapted for a case like this, nor would I suggest any turbine, nor as you suggest, set an inventor at work to evolve something new in the way of a turbine.

The well known hurdy-gurdy wheel of California is a far cheaper and more efficient type for very high heads, and I would refer to the very valuable paper of HAMILTON SMITH, Jr., upon water power under high pressures published in the Transactions Am. Soc. C. E., in which the wonderfully high efficiency attainable by this simple type of wheel if properly constructed, is demonstrated.

Although 2892 H. P. would be an unprecedented size for a single water-wheel of this (or any other) type, its design would not be at all impracticable. Yet for practical purposes a series of smaller wheels, each fed by a nozzle of 2 ins. or so in diameter, and all together using the same water and developing the same power, would serve almost any conceivable purpose better.

JOHN R. FREEMAN,
Hydraulic Engineer.

[We give our correspondent's letter in full, lest he might feel that our "hydraulic editor" was not giving him a fair hearing; but the whole question, and whole difference of views, lies in the interpretation to be given to the phrase "diameter of pipe." The original question having been very indeterminate, and apparently a merely theoretical one, we chose to answer it in the only way a definitive answer could be given, viz., "not taking friction into account," i. e., assuming that the diameter of discharging end only was 20 ins. and the rest of the pipe enough larger to permit of "not taking friction into account," under which conditions the 32,000 H. P. is by no means a "result so remarkable" as to be inconsistent with the remarkable hypothetical conditions, but on the contrary could, in fact, be realized by wheels adapted to the very unusual conditions after they were so adapted, as for example by the very efficient hurdy-gurdy wheels to which our correspondendent refers (Mr. SMITH's valuable paper was published in February, 1884), which gave as high as 87.3 per cent. of efficiency under 386 ft. head. Water pressure engines in the Comstock lode are said to have shown 90 per cent. of efficiency. Our correspondent chooses to assume a discharge pipe of only 8 ins. in diameter and pipe 1,600 ft. long, which may be nearer to what was intended. We simply answered the question as it stood, on the hypothesis that it was a purely theoretical one.—ED. ENG. NEWS.]

The Late Dr. George H. Cook, State Geologist of New Jersey.

NEW YORK, Sept. 26, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

Few men are better known to the readers of ENGINEERING NEWS than was the late Dr. GEORGE H. COOK, State Geologist of New Jersey; and as the writer had the good fortune to be closely associated with him for ten years, he feels that a few words of testimony to his rare worth and the value of his services will be appreciated. Dr. COOK began his career as a civil engineer. This was before he had reached his majority. He has told the writer how he worked all winter without an overcoat when he was running levels for the Morris & Essex railroad. He was always very hardy, and late in life he could tire out a young man in walking and climbing on his professional tours. We see here the first evidence of this hardy nature. He also surveyed the Catskill & Canajoharie road, an extension of the Morris & Essex railroad from Morristown via Mendham & Chester to Easton and a road from the Ogdensburgh zinc mines to Andover, New Jersey.

In order to better fit himself for his chosen profession he entered Troy Polytechnic Institute, graduating in 1839. We do not find him again in the field as a purely civil engineer, although he handled many important engineering problems, always solving them most satisfactorily throughout his later life. Indeed, it is a question whether the engineer or the geologist predominated in his career. His engineering training impressed itself on his whole scientific life. He always kept in view the economic importance of his researches, and economic questions and consideration predominated over purely scientific and theoretical matters in all his valuable contributions to knowledge, his annual and other reports. He gave as a reason for quitting the engineering profession what has been felt probably by most of us at some of the earlier stages of our careers, viz., that it required too great a sacrifice of the advantages of a fixed habitation. His was a nature which especially required to attach itself to a community, and which could not bear continual uprooting and transplanting. Hence we find him fixed at Troy from the time he entered the institute, becoming an instructor after graduation and, in 1842, senior professor. From here he went to the Albany academy, becoming principal in 1851 and holding the position for two years, when he was called to the Chair of Chemistry at Rutgers College.

In 1854 he became connected with the State Geological Survey as Assistant Geologist under Dr. WM. KITCHELL. Here began his series of exhaustive and valuable researches to which the economic development of the State owes so much. In 1863 he read a paper on the work of Prof. ROGERS and Dr. KITCHELL on the "State Surveys," before the Legislature of the State, by invitation. This led to the passage of an act to complete the Geological Survey of the State and the appointment of Dr. COOK as State Geologist, with a Board of Managers comprising eleven of the most illustrious men of the State. Governor JOEL PARKER was *ex officio* president. JOHN A. ROEBLING and Hon. ABRAM S. HEWITT were members. These gentlemen were all staunch supporters of Dr. COOK and his work to the last. It is to their enduring honor that they so fully appreciated his character and works and so ably seconded his efforts. From this date Dr. COOK's history is the history of the scientific and economic development of New Jersey, and to him in a large measure is due its phenomenal industrial progress.

He has himself fully set forth the history of the geological survey in his annual report for 1885. This, however, was by no means his whole work. It is only a fraction. He was the father of the State Scientific School, at Rutgers. He was instrumental in erecting Geological Hall, and very recently New Jersey Hall, both handsome and well appointed buildings; also in establishing the agricultural department, including a farm for experimental researches, over which he has exercised full charge for many years. He organized the State Experiment Station, an institution which has done invaluable work in its line. Long before, he organized the State Board of Agriculture, and always attended its meetings. He delivered many lectures on agriculture throughout the State annually. He was a member of the State Board of Health, useful here as everywhere. In 1886 he established and became director of the State Weather Service. He was for several years Surveyor General of East Jersey, and hoped to live to bring about a settlement of the affairs of that venerable body, the lords proprietors of East Jersey.

Among his important recent works in behalf of the State may be mentioned his services on the State Boundary Commission. The State limits he had long known to be unsettled and open to dispute. In 1876 the northern boundary was taken up and surveyed, the survey showing serious errors in the ancient survey. A commission of which he was a member finally agreed upon and re-marked this line in 1883. He was the member of a commission which in 1887 agreed upon and marked the boundary through Raritan Bay, and this commission was continued with authority to follow up the work through Staten Island Sound, New York Bay, and the Hudson this year. He attended a meeting of this commission on Sept. 20. They had agreed on the line as far north as the Battery. His loyalty to his State in all of these matters was proverbial. Between his own interests and those of the State, he would choose the latter invariably.

Nor was his influence and labor restricted entirely to his own State. He was a prominent and active member of the American Association for the Advancement of Science, and he often brought powerful support to the aid of some of the National Scientific Bureaus. He was never appealed to in vain to further scientific work, and his wide acquaintance with prominent men and the confidence which they had in his wisdom and integrity often went much further than the supposed all-powerful "pull" of the professional politician in securing support for good measures. Among his fellow geologists, his opinion carried the greatest weight. His reports on the geology of New Jersey were sought far and wide, finding their way to the continent of Europe. Thus every resource of the State was published abroad, for he never lost an opportunity to call attention to them.

With all his duties to the State and Nation pressing upon him, he did not forget those to his own city. He was for many years President of the Board of Water Commissioners of New Brunswick, and during all of that period the works were most admirably and honestly managed, yielding a steady revenue to the city even through the darkest times, when mismanagement was rife in almost every other department of the city government.

On election day he went quietly to the polls and cast his vote, nobody knew which way, but every one believed in the interests of good government. He was equally punctilious in his religious duties and in his domestic life, ever plain, simple, and straightforward, but a keen observer, and strong in his knowledge of human nature. When he had organized a department of his work and put whom he believed to be the proper person in charge, although he kept up fully with the progress of the work and always had advice to offer when needed, he never erred on the side of too much interference. He encouraged his subordinates to think and act for themselves, and this was the secret of his ability to accomplish so much good work.

Among his important engineering works were the drainage of the Great Meadows, on the Request, the working out of the water supply of the State and of plans for utilizing it, and very recently the drainage of the great tracts of wet land on the Passaic. The last work he has followed up with the greatest patience and perseverance, in the face of great obstacles, for 25 years, and success had just crowned his efforts when his career was closed. His advice was sought by many of our most prominent engineers, and no body ever consulted him without feeling that he had received valuable advice. The writer has in one day heard him discuss points of theology with theologians, of geology with geologists, of engineering with engineers, of chemistry with chemists, and of farming with practical farmers, all with equal clearness. He was, to an unusual degree, an all-round man, yet strangely enough he was regarded by every one as a specialist, and he was. He took a just pride in his geological survey, and I think its importance was always pre-eminent in his mind. He used frequently to remark that he felt he was nearing his end, and that he should leave the world happier could he live to see the topographical atlas of the State completed. He allowed nothing to stand in the way of this end. On Friday, Sept. 20, he read and approved the title-page of the new and first entirely complete edition of this atlas. So he just lived to see the work finished, as he so often wished, and it gives me no small satisfaction, revering his memory as I do, that his efforts were crowned with success, that he lived to see the dream of twenty years a reality. May all the excellences of that work stand as a monument to his noble character! If any imperfections appear, know that they are not in any wise attributable to him. He ever strove for honest, perfect work. Where shall we find his equal? Whence shall the State and Nation fill that vacant place?

* * *

Canal Head Gates of Iron.

Bear Lake & River Water-Works & Irrigation Co.
OGDEN, Utah, Sept. 25, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

Can you give me the name of a firm who a make specialy of iron canal head gates? By furnishing this information you will greatly oblige, Yours truly,

JOHN R. BOTHWELL, *President.*

The Sault Ste. Marie Canal Tonnage.

SAULT STE. MARIE, Mich., Sept. 24, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

In your issue of Sept. 14, p. 253, you give some statistics of the business through St. Mary's Falls Canal. In the column headed "Net Tonnage," I think there is some confusion, since *registered* tonnage has been used for the years 1881, 1882, 1883, and 1885, while *freight tonnage* is given for the years 1884, 1886, 1887, 1888, and 1889.

The correct tables are as follows:

Fiscal Year.	*Freight Tonnage.*	*Registered Tonnage.*
1881	1,258,468	1,802,571
1882	1,878,154	2,379,216
1883	1,874,404	2,130,181
1884	2,540,799	2,393,257
1885	2,870,728	2,981,786
1886	3,701,014	3,529,184
1887	4,882,802	4,368,691
1888	5,581,109	4,741,976
1889	6,032,303	6,213,494

In your estimate of the cost per mile per ton, you give for lake freights 0.12 cents. The cost for that freight which passed the St. Mary's Falls canal during the *season* of 1887 was 0.23 cents per mile per ton. This result is given on page 1,930 of report of chief of engineers for 1888. The same for the season of 1888 is 0.15. This result has not yet been published, but will appear in the report for 1889. Very respectfully,

E. D. WHEELER, *Gen. Supt., etc.*

[We gave the figures, as furnished us in manuscript, on what we supposed to be good authority, and are obliged for the correction. The rates on freight passing through the "Soo" would naturally average somewhat higher than the Chicago-Buffalo rate on which our average was based, as shown in the accompanying detail table, but the "Soo" rate will be seen to be rapidly approximating to it.—ED. ENG. NEWS.]

Notes and Queries.

F. W. Bird & Son, East Walpole, Mass., write us taking exception to our statements regarding the inflammability of the roofing paper described last week. They claim that if the paper is applied according to directions it is no more inflammable than shingles. They advise painting the paper after application with one or two coats of good paint. We have no doubt this would considerably decrease the inflammability of the paper, and increase its durability as well.

H. L. V. inquires: Can you inform me where I can find a description of GEORGE ENCOL SELLERS' plan for working inclines on a railway using a center rail and horizontal adhesive drivers? From Mr. WALTON W. EVANS' paper in Transactions Am. Soc. C. E., March, 1886, I learned that Mr. SELLERS published a pamphlet in Cincinnati in 1848, and that some large locomotives were actually built for the Panama Railway on his plan. Also that the Mont Cenis Railway was built on his system. If you can direct me where to find any printed description of his locomotives I shall be greatly obliged.

Some of our readers can doubtless give the desired information.

The Quadri-Centennial Exposition.

The Sub-Committee on Site and Buildings abandoned the effort to use Central Park as a site for buildings by passing the following resolutions on Oct. 2:

Resolved, That this committee hereby recommends the adoption of a site comprising Riverside and Morningside Parks, with adjacent lands, including approximately the district bounded by 110th St. and Fifth Avenue, 113th St. and Morningside Park; the district bounded by 108th St., Eighth Avenue, Morningside Park, 116th St. and Riverside Park, and the districts on each side of the Bloomingdale Asylum grounds from 116th to 122d St. the final boundary line to be subject to modification as may appear expedient when the compilation of details of ownership and terms of acquisition is completed. Sufficient area being thus obtained for the proper accommodation of the buildings, this committee recommends that no portion of Central Park be used for buildings for exposition purposes. It expresses the belief, however, that it will be found desirable and in the true interest of the public to include in the Fair inclosure the adjacent portion of Central Park, to afford amplitude to the grounds and the means of obtaining refrshment and repose without surrending the right of admission. Such annexation of the Park would extend the employment of its intended uses to the millions of visitors to the Fair, and should not involve any change in its topography or existing features.

That in the opinion of this committee every effort should be made to secure the needed land upon loan or lease, to which end a list should be compiled and published from day to day giving the names of owners of land within said area, and of the terms upon which each owner will give the use of his property for the purposes of the Fair.

That from the information thus far obtained the committee has grave doubts as to the feasibility of securing in this way the whole of the needed area, in which event the committee sees but one means of relief, namely, legislation, whereby such land as cannot be obtained as above indicated may be taken under condemnation proceedings by and in behalf of the city.

That, guided by the judgment of its professional and expert members, this committee records its conviction that the period remaining until May 1, 1892, is short at best for the accomplishment of the proposed work of construction, and that further delay in the commencement of actual preparations will seriously jeopardize the undertaking, and will tend certainly to impair the quality of the results.

That this committee has been prepared for several weeks to announce the terms of a competitive submission of plans for the principal buildings in order to inaugurate the necessary preparatory work, and that it is urgently desirable that the committee should be authorized to do this without further delay.

That, therefore, this committee respectfully advises that a meeting of the full Committee on Site and Buildings be immediately called to take definite and decisive action for the inception of active measures.

The Executive Sub-Committee of the Finance Committee called on the same day a meeting of the full committee for Tuesday, Oct. 8, when it is hoped a definite plan may be agreed on. It is seriously questioned, however, whether land for such a temporary and questionable "public use" as the buildings of a World's Fair can legally be condemned, while the value of the land to be taken is at least $100,000 per acre, allowing that it can be taken at all.

The French Association for the Advancement of Science.

Soon after the war of 1871 a group of eminent Frenchmen formed themselves into an association for promoting scientific research. This organization was modeled after the British Association for the Advancement of Science, which was formed in 1837 and for half a century has powerfully contributed towards scientific progress. The French Society has held annual meetings since in various provincial cities, Paris being twice selected—on the occasion of the expositions of 1878 and that of the present year.

Each year the association contributes considerable sums of money in aiding parties making costly experiments, in scientific exploration of various kinds, and in facilitating the publication of works which it deems useful. The amount distributed in this manner since the founding of the society is about $40,000. The expenses of the body are met by the annual dues of the members and by the interest on certain gifts and legacies, the principal of which now amounts to about $160,000. The average attendance at meetings is about 500.

The association is divided into seventeen sections, subdivided into four groups of mathematics, physics and chemistry, natural sciences, and economical science. The administration is in the hands of a Counsel named by the sections, and a bureau made up of a president and vice-president, a secretary and vice-secretary, and a treasurer. Each year the vice-president becomes president and the vice-secretary is made the secretary, and new officers are elected to fill the vacancies. And that each scientific group may be equally represented in the bureau, its members should belong respectively to each of the four groups. The treasurer is elected for four years. Finally, to the bureau is added, under the title of the Secretary of Council, an administrator whose term of office is unlimited. It is really this latter officer who prepares the work of the council of administration, who organizes the congress, who, in fact, is the general manager of the organization. This important post has been ably filled since the founding of the association by M. GABIEL, and to him it owes in a great degree its general success. Since 1886 an adjunct Secretary of Counsel has been in office, a position well filled by M. CARTAZ. At the meeting held during the present year in Paris, the President was M. DE LACAZE-DUTHIERS and the Secretary was M. FOURNIER.

The Sewerage of San Diego, Cal.

The Board of Public Works of San Diego, Cal., as required by the charter, has assumed the management and control of the sewerage system of that city, and hence JAMES D. SCHUYLER, C. E., JOS. FALKENHAM and JOHN F. SINKS, Commissioners of Public Works, have lately sent in to the Common Council a report covering recommendations for the extension and improvement of the system.

The obnoxious outfall first receives their attention, the sewer tank there at low tide giving out an intolerable stench. A survey made by the City Engineer showed a deposit exceeding 750 cu. yds. of putrescent matter, covering the bottom of the tank to a depth of 6 ins. or more. This matter was never moved at low tide except to a very limited extent, and its removal could only be effected by scraping the bottom of the tank by hand at low tide, a steam pump having been tried without success. The commissioners had the tank cleaned by 12 men in 12 days; but they report that this "harbor reservoir," a novelty introduced by Col. WARING, is "a total and absolute failure," after the experience of more than a year in patient and costly endeavor by the city to make the device work as it was intended. The commissioners are unsparing in their condemnation of this portion of the work, and they do not hesitate to assert, "after deliberate investigation, that the entire plan of the sewage tank and the so-called automatic device for emptying it after the turn of the tide, is an unpardonable blunder, unqualified by a single redeeming feature. . . . The principle was wrong, the location an outrage, and the execution of the details of construction a reflection upon every one connected with it in a responsible way."

The report continues to say that the principle was

wrong because the sewage was conducted to a point so far below the mean sea level that for more than half the time it was a physical impossibility to empty the tank and discharge the precipitated solids. To act as it was intended, the bottom of the tank should have been two or three feet higher. The tank itself is a wooden structure composed of piles driven in lines 10 ft. apart, with 3-in. plank spiked to the inside of piles; the space between the piles is filled with clay and covered with plank. After the tank was enclosed, the bottom was filled to a level of mean low tide "with earth, gravel, clay, hard-pan or broken sandstone, in large masses, everything in fact available in ordinary street grading in San Diego, dumped loosely from the deck of the scow used for its distribution, in piles here and there, without any attempt at packing, spreading, or levelling up to an even slope in any direction. Irregularities of 2 ft. or more in level appear, with occasional holes of greater depth." The bottom was, as a consequence, so rough that, even if it were high enough to be drained, it would be impossible to flush and keep it clean.

The "automatic" gate was intended to open some time after the tide had turned to ebb. But instead of opening suddenly, so as to produce a rush of discharge from the tank, and so scour the bottom, it opened so slowly that its purpose was entirely defeated. The proportionate cross-sectional areas of the outlet pipe and the sewage tank, with a ratio of 100 to 1, would also have rendered the scheme a failure, even had the bottom of the tank been high enough and made of smooth concrete, for precipitation would surely have taken place, and this precipitate could not have been removed except by hand sweeping.

The deposit formed was subject at times to intense rays of the hot sun, and the mass became putrid and offensive in the extreme, as well as positively dangerous to health. The tank should have been covered with a roof. The sewage in the tank on L Street accumulates for 24 hours before discharge, and a considerable deposit of sludge is left sometimes for weeks on the bottom. But as this tank is tightly covered and kept from contact with sun and air, no offensive odors are perceptible although it is surrounded by dwellings.

The shape of the outlet reservoir is also criticised in the report. The sharp corners form eddies, which receive the floating matter and keep it beyond the little scouring action there is. The report continues to say that this reservoir could have been located so that its discharge would have been in the ship channel, and a saving would then have resulted of nearly one-half the length of 24-in. pipe, and less than half of the 30-in. pipe, a saving of between $15,000 and $18,000. The shorter line would also have given a better grade to the main sewer and less liability to obstruction. The entire cost to the city of this strongly condemned work was $65,789, including the wharf over the 24-in. pipe.

The present location of the sewage tank was reported as highly objectionable by GEORGE J. SPECHT, C. E., who represented Col. WARING in the earlier stages of the work. But Col. WARING personally assured the Council on April 15, 1887, that he had thoroughly examined the matter of the outlet and that it was unnecessary to carry the sewage further away. Upon this assurance the contract was signed with him for 6 per cent. of the cost of the system for supervising the execution of the work.

In order to effect a temporary abatement of the present nuisance and to continue the use of the system without radical change, the report recommends as follows: A direct connection to be made across the sewer tank from the end of the 24-in. pipe to the gate-house by a tight wooden flume, 10 x 8 ft., provided with a hinged gate at its lower end, set on a slight incline so as to close automatically with the rising tide and open when the water falls outside. This would cost about $800. The objection that sewage would, at times, be discharged on an incoming tide and thus be driven ashore, is not likely to be a serious objection for some years to come. A precedent for this is already established by Col WARING himself in the district south of L Street.

For a permanent plan of disposal, the report recommends a higher intercepting sewer carried entirely around the city, and the contents to be conveyed to a 200 acre tract south of the Government dyke and there cared for, or disposed of in irrigation. The commissioners favor the latter plan. This main intercepting sewer is estimated to cost $115,302.40, and on the grade proposed a 24-in. pipe would carry 946,000 galls. of sewage per day with the pipe but half full, a capacity that would undoubtedly suffice for many years. It is suggested that in view of the scarcity and demand for water for irrigation, a revenue could be obtained from this sewage delivered to tertile land.

In treating of the pipe system, the report says that it has worked satisfactorily, though the sewerage system in use does not cover over one-tenth of the sewered district. Out of 11,743 house connections provided for, only 813 are actually used. The main sewer is equal to a discharge of 4,873,000 galls. per day, running half full. Careful gauging, extending over three weeks, shows the maximum rate of flow now to be 467,000 galls. per day, for a few hours on Monday morning; on other days the average flow is between 150,000 and 250,000 galls. per day. The present rate of maximum flow would thus have to be increased eight-fold before overcharging the main sewer, which has never been choked. But the case is different with the 6-in. mains. Taking the Fourth St. sewer, with 73 connections out of 354 provided for, it is found that it frequently runs more than half full, and any considerable increase in connections will render it liable to break down. As far as the commissioners were able to ascertain, only three stoppages have occurred in the San Diego sewers, though numerous stoppages have occurred in the house laterals. The report concludes that the system is defective in too small mains, too small laterals, defective flush tanks, and the absence of necessary manholes. The Field automatic flush tank has frequently failed to flush, owing to imperfect setting. These tanks are also found to range in capacity from 115 to 180 galls.

The expense for flushing sewers has been about $200 per month. Assuming an average of five persons to each sewer connection, it appears that only 4,000 out of 30,000 population are making use of the sewers. The annual cost of the system, including interest on bonds, water, and general repairs, is about $32,000 per annum. Fault is also found with the design and manner of setting of the inspection Ys, and the commissioners believe these must soon be replaced with manholes.

The report does not condemn the system wholly; and the commissioners believe it can be made thoroughly efficient, and point out the defects in order that measures necessary to maintain the efficiency of the system may not be neglected. A remedy for the small mains will be to lay one or two lines of higher intercepting sewers, and thus divide the system into belts; these high sewers are, however, not immediately needed. From a report of O. N. SANFORD, late City Engineer, it is shown that there are in the sewerage system 179,183 ft. of pipe varying from 6 to 24 ins. in diameter; including outlet, the total length of sewers is 40 miles. The total cost of pipe laid, including house, inspection, and street Ys, was $237,671.13.

Economic Head for Long Pipes.*

The subject-matter of this paper is intended to apply mainly to wrought-iron pipes of large diameter, having tapered inlet and free outlet, and designed for the delivery of a considerable volume of water, and not for the development of power.

In a general way it may be said that the costs of such pipes, of the same make, are approximately proportional to their weights, i. e., to the products of their lengths, diameters, and thickness of iron used in their manufacture.

Let H be the difference of level between inlet and outlet.
L " the length of the pipe.
D " the diameter.
t " the thickness of the iron.
k " Weisbach's coefficient of friction.
Q " the volume of water delivered per unit of time.
k " the cost of the pipe per unit of length at any point.†
K " the total cost of the pipe.†

* By ROSS E. BROWN in Transactions of the Technical Society of the Pacific Coast.

†The cost of transportation and distribution of the pipe may be added where these are proportional to the weight, but the cost of preparing the bed for laying the pipe is not considered.

c_1, c, c_3, c_4, c_5 be constant coefficients.
h_1 be the head corresponding to the least thickness of iron which it is practicable to use.‡
A " the area between the hydraulic grade line and the approximate profile of the pipe line + the additional area due to h_1.
h " the head governing the thickness of the iron at any point. This represents the variable ordinate of the area A.

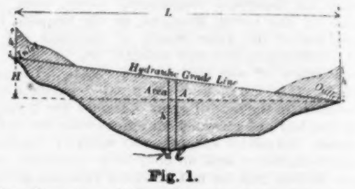

Fig. 1.

The diameter of the pipe is assumed to be uniform, and the thicknesses of iron proportional to the values of h. The fact that the latter condition can only be approximated will not materially affect the conclusions reached.

$$t = c_1 Dh \quad \ldots\ldots (1)^{**}$$
$$k = c_2 Dt = c_3 D^2 h \quad \ldots\ldots (2)$$
$$K = c_2 D^2 \int_0^L h dl = c_3 D^2 A \quad \ldots\ldots (3)$$

Equation (3) may be used in making a preliminary estimate of the cost of the pipe; but as the stated object of the pipe line is the delivery of a fixed volume of water, in order to reach a criterion of economy the cost must be expressed in terms of Q.

In applying Weisbach's formula

$$Q = \frac{\pi D^2}{4}\sqrt{\frac{2gH}{1 + k\frac{L}{D}}} \quad \ldots\ldots (4)$$

to pipe lines of any considerable length, the value of $k\frac{L}{D}$ is so great that the 1 may be neglected without serious error, and by transformation

$$D = c_4 Q^{0.5}\left(\frac{L}{H}\right)^{1.5} \quad \ldots\ldots (5)$$

Introducing this value of D for the delivery of a given volume of water, into equation (3), we obtain

$$K = c_5 Q^{1.5}\left(\frac{L}{H}\right)^{2.5} A \quad \ldots\ldots (6)$$

It is apparent that the cost of the pipe for the delivery of a given volume of water is measured by the quantity $A\left(\frac{L}{H}\right)^{2.5}$, and the smaller this quantity can be made, the less the cost.

It is not uncommon to meet with cases where the head H is unnecessarily great, and where it is a matter of economy to carry the water a part of the way from the source of supply in ditches or flumes, or even in light pipe, broken at intervals, to avoid the necessity of using heavy iron.

In estimating the cost of a very long pipe, I was somewhat surprised to find how low was the most economic head, H, governing the proper location of the inlet of the pipe.

In the following example there is assumed an abrupt slope and a long plane, such that the head, H, may be varied without materially affecting the length.

Fig. 2.

In this case

$$A = \frac{L}{2}\left(\frac{H^2 + h_1^2}{H}\right) \text{ hence } K = \frac{c_5 Q^{1.5} L^{2.5}}{2}\left(\frac{H^2 + h_1^2}{H^{2.5}}\right)$$

‡ With diameters from say 1½ to 5 ft., such minimum thickness may be regarded as approximately proportional to the diameters. In general $t = c_1 Dh$, and we may consider h_1 as constant within the limits of diameter named.

** For double-riveted sheet iron pipe, such as commonly used on the Pacific coast, $c_1 = .00016$ to $.00024$ for unit of dimensions 1 ft.

§ The value of k varies with D and velocity, but may be taken for the purpose of preliminary estimate as having a constant value, say

$$k = .02, \quad D = .22\, Q^{0.5}\left(\frac{L}{H}\right)^{1.5}$$

for unit of dimensions 1 foot, unit of time 1 second. It is not the purpose of the present paper to discuss the value of coefficients c_2, c_3 and c_4.

see equation (6). And this value of K is a minimum for

$$H = h_1 \sqrt{2^{1}/_{3}}$$

Or it may be said the cost of the pipe is approximately a minimum for $H = \frac{7}{5} h_1$.

For double-riveted sheet-iron pipes having diameters between $1^{1}/_{2}$ and 5 ft., if the mean value of $c_1 = .00002$ is used, the value of $h_1 = 165$ feet may be adopted. The cost, then, in the above case will be a minimum for $H = 250$ feet, and this approximates the truth, whether the length of the pipe be 1 mile or 100 miles.

In the following example there is assumed an abrupt fall from the inlet, a long plane, and an abrupt rise to the outlet.

Fig. 3.

In this case

$$A = \frac{L}{2}(H + 2m),$$

and K becomes a minimum for

$$H = \frac{4\,m}{3}$$

If m is less than h_1 this result will be modified.

These cases may be applied to the Sierra Nevada water supplies formerly proposed for the cities surrounding the Bay of San Francisco. The profile of a possible pipe line through Sacramento, Benicia, San Pablo, to Oakland, is about as follows:

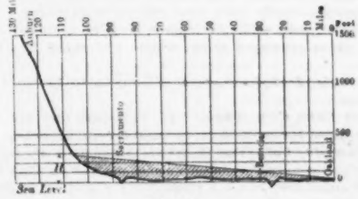

Fig. 4.

Owing to the fact that by decreasing H the length of the pipe is somewhat decreased, it is apparent that the most economical head, H, is liable to be even less than 250 ft.

This applies to the delivery of the water at the city base. A simple calculation will show that, with so long a pipe line (100 miles or more), there is no economy in attempting to deliver the water under such pressure as is required for the city service. A large saving is effected by delivering the water at or near the city base, and then pumping it to the city service reservoir.

If, for example, there is considered the supply of 10,000,000 galls. of water daily from the Sierras to a reservoir back of Oakland, having an altitude 200 ft. above the city base, the cost of delivery under the system of high pressure will exceed, by a million and a half dollars or more, the cost of delivery to the city base + the capital represented by the annual cost of pumping.

This is illustrated graphically in the following diagram—the areas representing cost—the total area the cost of the high-pressure pipe:

Fig. 5.

In the estimate upon which the diagram is based the price of the pipe was obtained from a large manufacturing firm.

If the length of the pipe were only 30 or 40 miles, there would be required a more careful estimate to determine the choice between the two systems.

THE NEW SHARON (ME.) WATER POWER CO. has nearly completed a timber dam 36 ft. wide at the bottom. It is expected that many manufactories will be located at New Sharon.

What a Little Forethought Did.

The work upon the London & Southwark subway or tunnel under the Thames, three miles long, has been in progress for three years. Recently, after the tunnel had passed, some householders in buildings overhead discovered cracks in their walls, for which they promptly demanded damages. When the case came to be heard, the engineer produced photographs of the walls in question taken before the tunnel workings reached them, and showed that the cracks complained of were old ones. It proved that the engineer, as a measure of precaution, had carefully photographed every wall and building likely to be affected by the excavations for the tunnel.—*Mechanical News.*

TELEPHONING.—The longest distance over which conversation by telephone is daily made is between Portland, Me., and Buffalo, N. Y., about 750 miles. ——There are more than 170,000 miles of telephone wire in operation in the United States, over which 1,055,000 messages are sent daily.——About 300,000 telephones are in use in the United States.

RAILWAYS.

EAST OF CHICAGO—Existing Roads.

Philadelphia & Reading.—Work is being pushed on the new branch running from the main line at Lower Manayunk, Pa., along the Schuylkill Navigation Company's tow path to a connection with the Norristown branch at Flat Rock. The masonry bridge which is to replace the present tow bridge is well advanced toward completion. Work on the eastern abutment has been commenced and work on the river piers will soon begin. ——The required 10 per cent. of the capital stock has been paid in, and it is stated that work will soon commence on the branch road from Winslow Junction to Cape May, N. J., 35 miles.

Lehigh Valley.—It is stated that this company will use a portion of the proceeds of the recent issue of $3,000,000 of bonds to build the Schuylkill & Lehigh Valley R. R., from Tremont to Lehigh Gap, 35 miles.

Baltimore & Ohio.—The Seneca & Potomac R. R. Co. has been incorporated to build the branch from Boyd's Station to the mouth of Seneca Creek, Md.

Concord & Montreal.—This company has completed its organization by the election of the following officers: President, FREDERICK SMYTH, of Montreal; Clerk, W. M. CHASE, of Concord, N. H., and Treasurer, J. FRANK WEBSTER, of Concord.

Penn Mountain Switchback.—This 5-mile gravity road near Reading, Pa., has been completed and opened for traffic.

Cooperstown & Charlotte Valley.—The 5-mile section from Cooperstown Junction to West Davenport, N. Y., has been completed. Work is well advanced on the line between West Davenport and Davenport, and this portion will be completed within a month.

McKeesport & Belle Vernon.—This road has been completed to Belle Vernon and will be opened for traffic Oct. 7.

Vincennes, Oakland City & Owensboro.—It is stated that the contract for building this road has been let and that work on construction will soon begin.

Pennsylvania, Poughkeepsie & Boston.—The large bridge across the Delaware river at Portland, Pa., has been completed and trains will be running over it in a short time.

Central R. R. of New Jersey.—It is stated that instead of repairing the damage down to the line from Seabright to Sandy Hook, N. J., by the recent storm, this company has decided to build a new line running from Seabright northwesterly across the salt meadows to the Matawan spur running to Atlantic Highlands and to make Atlantic Highlands the terminus instead of Sandy Hook.

Canadian Pacific.—Work on the Ontario & Quebec R. R. is progressing rapidly. The grading is all finished with the exception of a small amount west of London, where there is a heavy grade, and from the slip up to the level lands at Windsor, Ont. The tracklaying is three-fifths done and ballasting is going ahead rapidly. It is expected that the road will be opened for freight traffic in December and for passenger purposes in the spring.

Rockaway Valley.—J. E. V. MELICK, of New Germantown, N. J., Chief Engineer, sends us the following in regard to the extension from New Germantown to Pottersville:

The road runs in a nearly straight line from New Germantown to Pottersville, 4 miles. The grades and curves are light. There will be a bridge across the Lamington river. The line will do a general local freight and passenger traffic. Tracklaying has been completed and the road will be opened for traffic Nov. 1, 1889. Work is being pushed on a further extension to Peapack, N. J., and it is expected that the line will be completed to that place by Jan. 1, 1890.

Pennsylvania.—This company is securing right of way for an extension of the Little Sewickley Branch from Greensburg, Pa., north about 10 miles. The object of the branch is to open up the coal and coke fields along the route.

Grand Trunk.—An official of this company is reported as saying that the company would soon obtain a line to the Atlantic coast at St. Johns and Halifax. The proposed line will run from Levis, P. Q., to Rivière du Loup, P. Q., via the Intercolonial Railway, from Rivière du Loup to Edmundston, N. B., via the Temiscouata Railway, and from Edmundston a line will be built to Moncton, N. B., and thence to St. Johns and Halifax. Surveyors are now in the field.

Projects and Surveys.

Dexter & Ontario.—This company has filed maps and profiles for a railway to run from Brownsville to Dexter, N. Y., a distance of 2 miles. J. A. OUTTERSON, of Dexter, is President.

Homestead Connecting.—Incorporated in Pennsylvania, to build a line of railway 4 miles in length in the county of Allegheny, Pa. Among the incorporators are: CHAS. E. SPEER, HARRY BROWN, and GEO. C. BURGWIN; all of Pittsburg.

Keene & Brattleborough.—A line of railway to run from Keene, N. H. to Brattleborough, Vt., a distance of about 15 miles, is being talked of.

Poughkeepsie & Southeastern.—The surveys for this road, which is projected to run from Poughkeepsie to Hopewell, N. Y., 11½ miles, have been completed and it is stated that contracts will soon be let. H. F. KEITH, of Poughkeepsie, is Chief Engineer.

United Counties.—This company proposes to build a railway from Iberville to Sorel, P. Q.

Bradford County.—The question of building a line of railway to connect the Morrison's Cove and Bedford divisions of the Pennsylvania R. R. is being agitated by the people of Bradford County, Pa. There are three routes proposed,—from Cessna north across Bedford county, from Mt. Dallas to Ore Hill, and from Napier to McKee's Gap.

Atlantic, Mexican & Pacific.—The *Cleveland Leader* is responsible for the statement that a new transcontinental line will be a reality of the near future. The proposed road is to run from Toledo, O., across the States of Indiana, Illinois, Missouri, Arkansas, and Texas to Mazatlan, Mex., on the Pacific coast. "English capital," it is stated, has taken hold of the enterprise. A DALE OWEN, of Philadelphia, is President.

Fort Plain, Johnstown & Saratoga.—It is announced that the capital for constructing this road has been secured, and that work will commence next month between Dolgeville and Johnstown. The line is projected to run from Utica, N. Y., via Johnstown, Gloversville, and Dolgeville, to Saratoga, N. Y. WM. CLARK, of Fort Plain, N. Y., is interested.

SOUTHERN.—Existing Roads.

Darien Short Line.—Tracklaying will soon commence on this Georgia road. A large amount of rails is on the way from New York. Cross-ties are being laid and it is stated that the line will soon be in operation from Darien to Waithourville, Ga.

Norfolk & Carolina.—Grading is nearly completed on this road, which is to run from Norfolk, Va., to Tarboro, N. C., about 100 miles. E. ALLEN JONES, of Norfolk, Va., is Chief Engineer.

Cumberland Valley.—CHAUNCEY IVES, of Chambersburg, Pa., Chief Engineer, sends us the following:

The road runs from Martinsburg, W. Va., via Bunker Hill, to Winchester, Va., a distance of 23¼ miles. The route is through an undulating prairie country affording very easy grades and curves. There are two stone bridges on the line,—at Darkesville, W. Va., consisting of two arches of 40 ft. span each, and at Bunker Hill, Va., consisting of two arches of 50 ft. span each. The principal business of the road is in grain, lumber, coal, and general farm produce. The road was completed in June, 1889, and opened for traffic Sept. 23, 1889. Pickert & Keons, of Pottsville, Pa., had the contract for building the 13½ miles in West Virginia, and King & Waterville, of Mahony, Pa., for the 9 miles in Virginia. The road is laid with 60-lb. steel rails, and white oak ties and stone ballast are used.

Owensboro, Falls of Rough & Green River.—This road has been completed from Owensboro to Fordsville, Ky., 26 miles, and will be opened for traffic shortly.

Atlantic & Danville.—The construction of this road from Danville east is nearly completed. The line from Danville, Va., to Milton, N. C., was opened for traffic Oct. 1, and it is expected that the road will be completed to Clarksville, Va., by Nov. 1.

Columbus Southern.—About 15 miles of track have been laid on this road, and it is expected that trains will be running into Cusseta, Ga., in a few days. The road is to run from Columbus to Albany, Ga., 87 miles. W. S. GREEN, of Columbus, is Chief Engineer.

Louisville & Nashville.—The survey for the branch to Tuscaloosa, Ala., has been completed.

Louisville, New Orleans & Texas.—The line from Rosedale to Coahoma, Miss., 50½ miles, has been completed, and will be opened for traffic Oct. 1. At a meeting of the citizens of Crystal Springs, Miss., it was decided to take measures to induce this company to build a branch line to that place. It is stated that the com-

pany has promised to build the branch if it can be shown that a freight business amounting to $20,000 annually can be secured.

Georgia Pacific.—It is stated that contracts have been awarded to Gibson & Corpening, of Birmingham, Ala., to build a branch from Itta Bena, Miss., through the Yazoo Valley toward Memphis, Tenn., 40 miles.

Cincinnati, Alabama & Atlantic.—Articles of consolidation of the Cincinnati, Alabama & Atlantic Railroad Company with the Cincinnati, Huntsville & Birmingham Railroad Company and the Cincinnati & Birmingham Railway Company, have been registered. The consolidated company bears the name of the first of the three mentioned.

Tennessee & Coosa River.—It is reported that the Louisville & Nashville R. R. Co. has purchased this road, and will extend it from Attalla to Guntersville, Ala., 85 miles.

Alabama Midland.—Work on this road is rapidly nearing completion. The entire line is now graded, with the exception of five or six miles in the neighborhood of Troy, Ala. The grading forces are now working toward Troy from Ada and Ozark, and the grading will be completed in a week or two. The company expects to have the entire line in operation from Montgomery to Bainbridge, Ala., by Dec. 1.

Projects and Surveys.

Stevenson, Sand Mt. & Dalton.—Incorporated in Alabama to build a line of railway from the town of Stevenson to a connection with the Birmingham Mineral R. R., near Walnut Cove; also to construct a branch from the main line at Higdon to a point on the Georgia State line. Among the incorporators are: RUSSEL FARNHAM, Bradford, Vt., GEO. LITTLE, Oxford, Miss., and THOS. LUMKIN, Trenton, Ga.

Greenville & Southeastern.—This company proposes to build a railway from Greenville to Elba, Ala. The officers are: D. G. DUNKLIN, President, A. STEINHART, Secretary, and J. T. STEINER, Treasurer.

Mount Sterling.—Arrangements have been made by the Mt. Sterling Commercial Club for the survey of a railway to run from Mt. Sterling, Ky., to either Davis or Indian Fields, Ky.

Bowling Green & Northern.—It is stated that the contract for building this road, which is to run from Bowling Green to Litchfield, Ky., 40 miles, has been let to C. H. DISHMAN. Work is to begin in 60 days and the road completed by Jan. 1, 1891. M. H. CRUMP, of Bowling Green, Ky., is Secretary.

Walterboro & Yemassee.—Surveys for this road, which is projected to run from Walterboro to Pregnall's, S. C., 20 miles, will begin about Oct. 1. GORDON GARDINER, of Pregnall, is Chief Engineer.

West Virginia & Pennsylvania.—This company is at work securing the right-of-way for its proposed road. The road is to run from Rowlesburg, W. Va., to the Pennsylvania State line, 27 miles.

Greensboro, Roxboro & Eastern.—Organized in North Carolina to build a railway from Blue Wing, in Roxboro to Greensboro, N. C. Capt. THOS. B. KEOOH, Greensboro, is President.

Albany & Cordele.—Sufficient money has been raised to have the survey of this road continued from Cordele to Hawkinsville, Ga., about 30 miles. Surveys have been completed from Albany to Cordele, Ga., about 35 miles. J. W. ROBERTS, of Albany, is Chief Engineer.

Mount Pleasant & Seaview City.—At a meeting of the directors, recently held, it was voted to sell this road, to J. P. KENNERLY, who agrees to commence the survey of the road in 40 days and to begin construction within 10 months. The road is projected to run from Charleston, S. C., to Seaview City, S. C., 7 miles. The offices are at Charleston.

Belmont & Fredericksburg.—JAS. L. POWELL, and others, of Belmont, Va., have formed a company to build a railway from Belmont to Fredericksburg, Va.

Macon & Birmingham.—Sealed proposals will be received until Oct. 7, for building this road, which is to run from Macon, Ga., to Birmingham, Ala., 210 miles. W. H. WELLS, of Macon, is Chief Engineer.

Georgia.—Bills have been introduced into the Georgia State Legislature, incorporating the Simons Short Line, and the Albany, Florida & Northern Railway companies.

NORTHWEST.—Existing Roads.

Pacific Short Line.—DONALD MCLEAN, General Manager of the Wyoming Pacific Improvement Co., states that tracklaying on the division from Sioux City, Ia., to Plainview, Neb., will begin in a few days. Bids for grading and bridging 50 miles west from Plainview will be called for soon. The line from Ogden, Utah, east will be put under construction soon. The city of O'Neill, Neb., has voted $100,000 in aid of the road, on condition that it passes through that place. Three locomotives have been purchased from the Baldwin Locomotive Works, of Philadelphia, and it is expected that trains will be running to Plainview by the end of the year.

Illinois Central.—A press dispatch from Sioux Falls, Dak., states that a petition is being circulated for voting the remaining one-half per cent. to aid the extension of this road from Sioux Falls to Parker, Wheeler, and Aberdeen, Dak.

Canadian Pacific.—About 600 teams and 1,500 men are now at work on the Qu'Appelle, Long Lake & Saskatchewan R. R. Nearly 60 miles of the grading has been completed, and it is thought that the line will be completed to the Saskatchewan River this season.

Sioux City & Northern.—It is now expected that this road, which is to run from Merrill, Ia., to Palisades, Dak., 80 miles, will be completed this fall. L. F. WAKEFIELD, of Sioux City, is Chief Engineer.

Union Pacific.—Proceedings have been commenced for the forfeiture of the franchise of the Millidale extension of the Omaha & Republican Valley R. R., running from Kearney to Callaway, Neb. The charter was granted some 5 years ago, and the road graded, and ties and iron purchased, but nothing has been done since.

Great Northwest Central.—A. CHARLEBOIS, the contractor for this road, has sublet a contract for building 50 miles to Macdonald & Scheller, of Toronto.

Projects and Surveys.

Lake Superior & Northern Minnesota.—It is stated that surveys will soon be made for a railway to run from Grand Marais, Minn., northwest to the Vermilion Iron Range.

Hudson Bay.—A press dispatch from Sault Ste. Marie Mich., states that a syndicate of Canadian and American capitalists have applied to the Canadian Parliament for a charter empowering them to build a railway from a point on the St. Mary's River north to Hudson Bay, a distance of 370 miles. The object of the road is to open up the mineral and timber lands along the route and to form a new European route through the Hudson Strait. It is stated that surveys will commence about Jan. 1.

Duluth & Southwestern.—Incorporated in Minnesota by A. A. MEAD, of St. Paul, Minn., J. A. MCLEOD, of Minneapolis, Minn., and others to build a railway from Duluth, Minn., southwest to Cheyenne, Wyo.

SOUTHWEST.—Existing Roads.

Fort Smith, Paris & Dardanelle.—It is stated that this road, which is now completed from Fort Smith east 5 miles, will be extended, via Dardanelle, to Little Rock, Ark. L. L. BUSH, of Philadelphia, Pa., is President.

Weatherford, Mineral Wells & Northwestern.—Work has been commenced on this road, running from Weatherford northwest to the Parker county coal fields, and it is expected that the line will be completed in 3 months.

Texas Western N. G.—It is announced that arrangements have been made for the extension of this road, which runs from Houston to Sealey, Tex., 53 miles, from Sealey east to a connection with the Missouri, Kansas & Texas R. R., about 15 miles. The road is to be changed to standard gauge, new bridges built, and an entirely new equipment purchased.

New Orleans, Natchez & Fort Scott.—The contract for building this road from Natchez, Miss., to Rayville, La., 75 miles, was let to Bethune & Crary Bros., and Hammet & Morrison, of St. Louis, Mo. W. DUNBAR JENKINS, of Natchez, is Chief Engineer.

Pine Bluff & Swan Lake.—It is stated that arrangements have been made for a 10-mile extension of this Arkansas road.

ROCKY MT. AND PACIFIC.—Existing Roads.

Spokane Falls & Northern.—This road is now completed to Chewelah, W. T., 60 miles north of Spokane Falls. The line is to be completed to Colville, 90 miles north of Spokane Falls by Oct. 15, and on to the Columbia River as rapidly as possible. D. C. CORBIN, of Spokane Falls is at the head of the enterprise.

Puget Sound & Gray's Harbor.—This road has been graded as far as Montesano, W. T., and construction trains are now running to Elma, 12 miles from Montesano. IRA C. OTIS, of Montesano, is Chief Engineer.

Oregon Pacific.—WM. M. HOAG, General Manager, states that arrangements are nearly completed for the early resumption of work on this Oregon road, and that a large force will be put at work soon and the road pushed to completion as rapidly as possible.

Northern Pacific.—The contract for building the Northern Pacific & Montana, R. R., from Missoula to the Cœur d'Alienes, Mont., has been awarded to Woods & Larson, and work will begin in a short time.—About 35 miles of track has been laid on the Gallatin-Butte branch and the remainder of the line is well under way.

New Westminster Southern.—About 230 men are now at work on this road, which is to run from Westminster, B. C., south to the International boundary. Grading is well under way on the entire line, and tracklaying will begin as soon as the rails arrive from England and will be pushed rapidly forward. It is thought that the road will be opened for traffic by May 1, 1890.

St. Paul, Minneapolis & Manitoba.—Construction has been commenced on the branch from Great Falls, Mont., to the mining camps at Neihart. The branch will be about 60 miles long.

Oregon Railway & Navigation Co.—The extension of the Washington & Idaho R. R., from Rockford to Spokane Falls, 26⅞ miles, has been completed.

Projects and Surveys.

Georgetown, Silver Creek & Chicago Lakes.—Incorporated in Colorado to build a line of railway from Georgetown along the base of the Saxon and Columbian mountains to Silver Creek, Col. The principal business of the road will be in the transportation of ore from the miners along the route. The principal offices will be at Georgetown. Among the incorporators are: C. R. FISH, C. W. PALLARD, and A. B. FORBES.

Portland & Vancouver.—A press report states that articles of incorporation will soon be filed for the construction of a railway from Portland, Ore., via Vancouver, to Yakima, W. T.

Port Defiance.—This company has been incorporated to build and operate railways in Pierce County, W. T. Among the incorporators are: ISAAC W. ANDERSON, T. B. WALLACE, STUART RICE and others.

RAPID TRANSIT.

Street Railways.—*Brooklyn, N. Y.*—The franchise for a line on Montague St., from Court St. to the Ferry has been sold to the Montague Street Ry. Co.

Pittsburg, Pa.—The Market Square Street Ry. Co. has been incorporated by ROBERT FRASER, ALBERT EDWARDS, J. P. M. WILSON, JOS. MITCHELL, and W. W. MURRAY, of Pittsburg. Capital stock, $6,000.

Orangeburg, S. C.—The Orangeburg City Street Ry. Co. had its road completed in September. It was built by J. W. Craig. A dummy engine is to be purchased. President, J. W. H. DUKES; Secretary, B. H. MOSS.

Anniston, Ala.—The Noble St., Randolph & Wanamaker Line has been organized. President, J. LLOYD; Secretary, J. M. CALDWELL; Superintendent, W. CHADWELL.

Mansfield, O.—The street railway system is to be extended.

Toledo, O.—The narrow-gauge street railways are to be ordered to standard gauge. The franchise has been extended for 25 years.

Chicago, Ill.—The Chicago & Western Suburban Street Ry. Co. has been incorporated by JOHN MORTON, WM. HOLLER and EDMUND BAILEY. Capital stock, $150,000.

Marietta, Wis.—The contract for the street railway has been awarded to Driscoll & Gochnauer, of Appleton, Wis.

Duluth, Minn.—The Duluth Street Ry. Co. has increased its capital stock from $300,000 to $1,000,000.

Pierre, Dak.—Contracts have been let for extending the street railway 3 miles, which will make it a belt line.

Sturgis, Dak.—A street railway is to be built to Galena.

Salt Lake City, Utah.—The Salt Lake City Ry. Co has applied for permission to build several branches.

Alameda, Cal.—The Oakland, Alameda & Piedmont Ry. Co. has agreed to build a street railway on Park St.

Waxahachie, Tex.—A franchise for a street railway has been granted.

Electric Railways.—*Bangor, Me.*—The electric street railway will be extended to Hampden. Permission for the erection of poles and wires has been granted.

Albany, N. Y.—The Watervliet Ry. Co. contemplates extending its electric line to Cohoes.

Buffalo, N. Y.—The Buffalo Street Ry. Co. is experimenting with the Sprague Electric Ry. & Motor Co.'s system, using 4 cars.

Savannah, Ga.—The Belt Line is contemplating operating its cars by electricity, either on the overhead wire or the storage battery system. The Daft and Sprague companies have submitted propositions.

Milwaukee, Wis.—The Milwaukee & Wauwatosa Ry. Co. has been organized to build an electric line to Wauwatosa. The storage battery system will probably be adopted. An iron bridge will be built over the Menominee valley. President, T. H. RUMSEY; Vice President, JAMES PETLEY; Secretary, A. B. MYERS.

Faribault, Minn.—An electric street railway is projected.

Kansas City, Mo.—The Northeast Electric Ry. Co. has been organized. President, W. H. WINANTS; Vice President and Manager, E. A. PHILLIPS; Secretary, W. C. LEARRIT. The bonds, amounting to $250,000, have been taken by the Jarvis & Conklin Investment Co., of Kansas City and New York.

Armourdale, Kan.—The Armourdale & Kansas City Electric Ry. has been opened. An extension is now under construction.

Dallas, Tex.—The West Dallas Electric Ry. has been sold to T. L. MARSALIS, who will extend it and make it a belt line.

Whatcom, W. T.—An electric railway is to be built to Bellingham.

Elevated Railway.—*Sioux City, Ia.*—The Sioux City Rapid Transit Co. has decided to build its elevated road at once. Surveys have been made and material will be ordered very soon.

Cable Railways.—*Cleveland, O.*—The Superior Street Ry. Co. has been given permission to commence work. Mr. FRANK ROBISON is President.

Elevated Railway.—*Chicago, Ill.*—The Chief Engineer of the Lake Street Elevated Ry. Co. is J. L. BAIRD; and W. S. L. BAILEY, who was mentioned last week as the Chief Engineer, is Inspector.

HIGHWAYS.

Trinidad, Col.—Some good work is being done on the county road between Trinidad and El Moro, near San Rafael Hospital. The road is being graded, made wider and put in excellent condition. Lewelling's grading outfit is doing the work which was authorized by the county commissioners at their recent session.

Texas Roads.—The people of Texas cannot invest money in a better way than in their roads. There is no investment a people can make that will repay them as well as to put money into the improvement of their thoroughfares. Good roads are the best inducement a country can offer to homeseekers.—Titus *Times*.

Washington, D. C.—Mr. GEO. N. BEAL, Superintendent of county and surburban roads, has presented his report for the year ending June 30. The report shows that the expenses during the year amounted to $147,648.25, divided as follows: Current repairs of county roads $44,996.29; construction and repair of bridges, $87,036.04; ordinary care of bridges, $708.07; emergency fund, $2,913.23; sweeping, sprinkling and cleaning streets, $636.11; repairs streets, avenues and alleys, $370.27. In concluding his recommendations he urges the appropriation of $75,000 on account of current repairs to county roads, which, he says, is necessary in view of the frequent additions of new streets which are being dedicated by the owners of surburban property and which should be looked after.

Baltimore, Md.—A plan for connecting Washington with Baltimore by a magnificent boulevard was discussed in a paper recently read by Mr. JOHN C. K. HEINE before a meeting of the Landlords' Protective Association of Baltimore. Mr. HEINE says that the boulevard between the two cities should be made wide and well graded. It would connect Washington, by an avenue at least 150 ft. wide, with Baltimore, connecting there with Fulton Ave., where it is 100 ft. wide, and terminating in Druid Hill Park. The route of the boulevard, after going a few miles from Baltimore, should be over the Washington turnpike. He suggests that the road might be divided into sections: one of 30 ft. in width should be macadamized and used exclusively for heavy travel; another of equal width should be made of good hard material for foundation, rounded and topped off with fine gravel, and should be used exclusively for carriages and light wagons; another of equal width should be constructed of asphalt for light carriages, bicycles and the like—this would be peculiarly desirable in wet and wintry weather; and another, also 30 ft. wide, should be set apart for rapid transit, either by electric motors or cable cars. Thus there would be four parallel roads in the boulevard, still leaving 30 ft. for two sidewalks of 15 ft. each on either side of the boulevard. Mr. HEINE thinks that the road with all its embellishments would probably cost $50,000 per mile.

CONTRACTING.

Construction Materials.—At Louisville, Ky., the city has awarded contracts as follows: J. B. Speed & Co., for furnishing the city with cement and lime for 12 months, at 90 cts. per bbl. for cement and 75 cts. for lime. Henry Krupp & Co., for furnishing brick for new sewers and brick for sidewalk, sewer, and cistern repairs, at $6.10 per 1,000 for sewers and $8 per 1,000 for sidewalk brick. Thurman, Powell & Co., for furnishing cast and wrought iron, at 1.65 cts. per lb. for cast-iron, and 3½ cts. for wrought iron. H. A. Myers, for furnishing and putting down new footway crossings, at $2.50 per lin. ft. in the eastern district and $2.60 in the western. For broken stone, J. Gleason bid $1.30, and the Arnold Improvement Co. $1.05 for stone delivered on cars along the route of the Louisville, St. Louis & Texas Ry.

Street Work.—*Jackson, Mich.*—The contract for brick paving on Main St. has been awarded to T. C. Brooks & Co. at $1.86 per sq. yd.

Independence, Ore.—The contract for grading Main St. has been awarded to Wm. Jones at 30 cts. per cu. yd.

Oakland, Cal.—Proposals have been received as follows: For macadamizing 10th Ave., from 21st to 22d St.; Diggins bid 6⅞ cts. per sq. ft., Bailey & Lockwood, 7⅜ cts., and the Alameda Macadamizing Co., 7¼ cts. For improving Union St., between 20th and 28th, Diggins bid ¾ ct. per sq. ft. for regrading, 6¾ cts. for macadamizing, and 11¾ cts. for recurbing; the Oakland Paving Co. bid 1 ct. for regrading, 7 cts. for macadamizing, and 12 cts. for recurbing. For the macadamizing of East 20th St., between 9th and 10th Aves., Diggins bid 6¾ cts. per sq. ft., and the Alameda Macadamizing Co. bid 7⅛ cts. per sq. ft.

McKeesport, Pa.—A street improvement contract amounting to $13,000 has been awarded to Booth & Flynn, of Pittsburg.

Stone.—The following proposals have been received by the Docks Commissioners, New York City: For 2,000 cu. yds. of cobble stone: Brown & Fleming, 95 cts. per cu. yd. (awarded contract); John A. Bouker, 95 cts. For 400 cu. yds. of rip-rap stone: John A. Bouker, 58 cts. per cu. yd. (awarded contract); Brown & Fleming, 64 cts. For 500 cu. yd. of broken stone: Daniel E. Donovan, $1.64 per cu. yd. (awarded contract); Hudson River Broken Stone Co., $1.68; John A. Bouker, $1.73; West Shore Trap Rock & Crushing Co., $1.77; Brown & Fleming, $1.87; A. J. Howell, $1.90.

Sewers.—*Denver, Col.*—The following proposals have been received by the Board of Public Works for the construction of the sewers, and the contract has been awarded to J. E. Riley & Co.:

McGavock & McHugh, Omaha, Neb.	$119,982.39
T. H. O'Niel, Denver	116,868.54
S. Eisenhart, Denver	116,550.61
Rockford Construction Co., Rockford, Ill.	100,189.77
J. B. Hendry, Denver	92,487.55
Ryan & Fleetwood, Pueblo	91,966.13
W. A. Doyle, Fort Smith, Ark.	91,904.33
James Creighton & Co., Omaha	90,169.00
Moore & Clough, Denver	87,613.62
Joseph Williams, Denver	85,571.95
Christie & Lowe, Denver	83,279.44
J. E. Riley & Co., Omaha	75,853.13
Engineer's estimate	100,808.45

Piles.—The following proposals for 1,250 yellow pine Norway pine, cypress or spruce piles, have been received by the Docks Commissioners, New York City: A. J. Murray (awarded contract), $14 each for 70 to 80 ft. long, $9 for 60 to 70 ft., $7.50 for 55 to 60 ft. Beard & Kempland, $14.75 for 70 to 80 ft., $9.50 for 60 to 70, $9.75 for 65 to 70 ft., $8.50 for 55 to 60 ft.

Sewer Materials.—*Baltimore, Md.*—The following proposals have been received by the City Commissioner. Wolfe St. sewer: Guildford & Watersville Granite Co. $1.11 per 1,000; W. F. Weller, $1.19. For cement, John S. Bullock & Son, Round Top $1.10 per bl., Portland $3; C. C. McColgan & Co., Rosendale $1.20 and 95 cts; S. M. Hamilton & Co., Cumberland $1.35, Rosendale $1.30. For sand, J. P. McGovern, 78½ cts. per cu. yd. For bricks, hand made, Smith & Schwartz, $7.40; G. W. Robinson & Sons, $8.49; W. H. Perot, $7.50. For stone, rubble, John G. Schwind, $1.70 per cu. yd.; John Harris, $2.

For materials for the Eutaw and Fremont street sewer: Cement, S. M. Hamilton & Co., Cumberland, $1.35 per bbl. $1.10 per bag, Rosendale $1.30; C. C. McColgan, Ulster Co, $1.20 per bbl., 97 cts. per bag; John S. Bullock & Son, Round Top $1.10, F. G. Naughton $1.38, Portland $3. Piles, J. S. Hoskins, 6¼ cts. per ft. Bricks, J. R. Busey & Son, hand made $8.40, machine made $7.70; Y. O. Wilson Brick Co., hand made $9.20; machine made $8.40, Pitcher & Creager, hand made, $9, machine made $8.50; Carroll Brick Co., hand made, $7.45. Stone, per yd., John Harris, $1.95; John Curley, $1.95; David Leonard, $1.90; John G. Schwind, $2. Lumber, per 1,000 ft., B. M. Womble, $24.95. Sewer blocks, per 1,000, W. F. Weller, $1.17; McClanahan & Bro., $1.10; Guildford & Waltersville Co., $1.06. Sand, per cu. yd., Morgan & Bresnan, $1; M. Duvil, 60 cts.; M. F. Leonard, 69 cts.; Conrad Polster, 65 cts. The lowest bidders will receive the contracts. There were no proposals for sheet piling, which were advertised for.

Buildings.—The following proposals have been received by the King's County Commissioners, at Brooklyn, N. Y., for the construction of buildings at the county farm, St. Johnland:

L. W. Seaman, all the buildings	$730,000
P. J. Carlin, all the buildings	689,000
John H. O'Rourke, all the buildings	627,000
John H. O'Rourke, less the barn and ice-house	611,000
Edward Freel, all the buildings	651,000
Myron C. Bush, all the buildings	715,000
James W. Birkett, all the buildings	672,000
James W. Birkett, icehouse	5,800
James W. Birkett, barn	25,000
H. D. Southard, all the buildings	649,000

Dredging.—The following proposals have been received at Chatham, Ont., for dredging in the township of Dover, Kent County, Ont.: McCollom & Lee, of Thorold, $11,460; J. and J. Conlin, of Welland, 12 cts. per cu. yd.; Carkin, Stickney & Cram, of Cheboygan, Mich., 10 cts. per cu. yd., but stipulated for 6-ft. cut below water line; Chatham Dredging Co., $11,470. The work is 6 miles long, with a cut 25 wide in the bottom and 4 ft. below summer level of Lake St. Clair. It is wholly in plain land, about 18 ins. above water level, and is intended to carry the drainage of the higher lands to a proper outlet as defined by the courts. McCollom & Lee are expected to get the contract.

Steel Shells.—Proposals have been received at the War Department for the supply of 100 7-in. and 50 11-in. cast steel shells to the Ordnance Bureau. The bids were as follows: Standard Steel Casting Co., Thurlow, Pa., 7-in. shells, $59.50 and $64.85 each; 11-in. $127 and $137 each, each size of shell being divided into two classes, with octagonal and round cavities respectively. Midvale Steel Co., of Philadelphia, 7-in. shells, 40 cts. and 33 cts. per lb.; 11-in. shells, 37 and 30 cts. per lb. W. H. Lang, Goodhue & Co., Burlington, Vt., 7-in. shells, $46.08 and $51.84 each; 11-in. $132 and $145.20 each.

Fencing.—The following proposals for fencing lots have been received by the Commissioner of City Works, Brooklyn, N. Y.: P. Enners, 40 cts. per lin. ft.; Dennis Norton, 44 cts.; Edward Wade, 47½ cts.

PROPOSALS OPEN.

Dykes.—Brush dykes. Col. W. P. CRAIGHILL, U. S. Engineer Office, Richmond, Va. Oct. 8.

Sewers.—Manholes, basins, 12 and 15-in. pipe. H. J. STRATEMEYER, Jr., Street Commissioner, Elizabeth, N. J. Oct. 9.

Street Work.—Macadam and Telford paving, grading, sewers, etc. THE PARKS COMMISSIONERS, 49, 51 Chambers St., New York City. Oct. 9.

Sewers.—Brick sewers, 825 ft. of 6 ft. x 6 ft. 10 ins., 2,340 ft. of 5 ft. 8 ins. x 4 ft. 6 ins., 730 ft. of 4 ft. 8 ins. x 3 ft. 6 ins., 1,750 ft. of 44 x 32 ins., 1,460 ft. of 38 x 26 ins. Also 630 ft. of 18-in. pipe, 420 ft. of 15 in. and 3,250 ft. of 12-in.; 91 manholes and inlets, 1,100 house connections, 38 basins, 50,000 ft. of piles, 150,000 ft. B. M. of timber, 50 cu. yds. of concrete, 100 cu. yds. of broken stone, 50 cu. yds. of rubble masonry, 14,000 cu. yds. of rock excavation. THE PARK COMMISSIONERS, 49, 51 Chambers St., New York. Oct. 9.

Road Work.—Grading and improving roadbed. JOSEPH HUSSON, 93 Nassau St., New York City. Oct. 10.

Sewer.—Materials for Jenkins run and Carter alley sewer. A. E. SMYRK, City Commissioner, Baltimore, Md. Oct. 11.

Public Works.—At Longueuil, Que. A. GOBEIL, Secretary Department of Public Works, Ottawa, Canada. Oct. 12.

Bonds.—Bonds for Colerain Ave. bridge. F. RAINE, County Auditor, Cincinnati, O. Oct. 12.

Culvert.—Semicircular arch culvert. THE COUNTY COMMISSIONERS, Cincinnati, O. Oct. 12.

Electric Lighting.—WM. ELLIOTT, Town Clerk, Seaforth, Ont., Canada. Oct. 12.

Steel Castings.—For gun carriages. JAMES FULTON, Paymaster-General, U. S. N., Navy Department, Washington, D. C. Oct. 15.

Road.—Wagon road through Bear River Cañon. Price not to exceed $4,400, including bridges and culverts. J. P. MAXWELL, State Engineer, Denver, Col. Oct. 15.

Cross-Walks.—Stone cross-walks. F. B. CROCKER, President, Board of Public Works, Denver, Col. Oct. 21.

Bridge.—Automatic, self-closing, swing bridge over the canal; iron pile substructure. THE COUNTY COMMISSIONERS, Cincinnati, O. Oct. 26.

MANUFACTURING AND TECHNICAL.

Market Prices.—*Rails.*—New York and the East; $29 at Eastern mills. Pittsburg: $32, the mills have plenty of orders ahead. Chicago: $33 for standard sections, $36 to $37 for 35 to 40 lbs.

Track Material.—Pittsburg; orders are large and prices have an upward tendency; spikes, 2.10 to 2.15 cts., 30 days; splice bars, 1.85 to 1.90 cts.; track bolts, $2.75 to $2.80 with square nuts, and $2.85 to $2.90 with hexagon nuts.

Nails.—Chicago; jobbers have advanced the price of steel nails to $2.20, wire nails to $2.50, with 5 cts. off for car loads. This is in consequence of higher rates of 5 to 10 cts. made by manufacturers.

Building Material.—Haverstraw hard bricks, $5.75 @ $6.25 per 1,000; Fishkills, $5.62½ @ $5.87½; up-river hard, $5 @ $5.75. Jerseys, $4.50 @ $5.25; pale bricks, $3.25 @ $3.75; Croton dark and red, $15 @ $16; Croton brown, $14 @ $15.——Rosendale cement, 95 cts. @ $1.10 per bbl.; American. Portland, $2 @ $2.10; English Portland, $2.10 @ $2.25; German Portland, $2.30 @ $2.70.——Rockland common lime, $1 per bbl., and do. finishing, $1.20; State lime, 85 cts.; St. John's lime, 90 cts. @ 95 cts.——Laths are worth $2.15 @ $2.25 per 1,000.——Goat's hair is worth 23 cts. to 28 cts. per bushel; cattle hair, 14 cts. to 18 cts.

Cable Railway Plant.—The firm of Robert Poole & Son Co., of Baltimore, Md., has very extensive works for the manufacture of cable driving plant for street railways, of which class of work this firm makes a specialty. The driving plant of the 10th Ave. cable railway, New York, was built at these works. The works occupy about 15 acres, and are built of stone and brick. The iron foundry is 270 ft. by 100 ft.; machine shop, 530 ft. by 60 ft.; erecting shop, 125 ft. by 80 ft.; smith, 180 ft. by 53 ft.; boiler shop, 175 ft. by 70 ft.; pattern shop, 68 ft. by 40 ft.; and storehouse for stock of finished machinery, 175 ft. by 75 ft.

The Pittsburg Bridge Co., of Pittsburg, Pa., has issued a neatly got up, illustrated catalogue. The firm makes a specialty of iron and steel highway bridges, and has done a large amount of work in this line. President, J. A. NICHOLS; Engineer, F. L. GARLINGHOUSE.

Steam Pumps.—The Woodward Steam Pump Co., of New York, issues an illustrated circular showing the advantages of its special makes of pumps, which are quite extensively used.

The New York & New Orleans Coal Iron Co. has been incorporated to develop coal and iron fields in Tennessee, establish steel works and rolling mills, etc. President, LOGAN H. ROOT, Little Rock, Ark.; Vice-President, CHARLES P. RICHARDSON, Chattanooga, Tenn.; General Manager, I. KIMBALL, Atlanta, Ga.

Wrought-Iron Pipe.—The manufacturers of wrought iron pipe and boiler tubes held a meeting at Pittsburg in September. All of the 20 mills of the country were represented, including the Reading Iron Co., which controls the property lately belonging to the Reading Iron Works, Reading, Pa. It was the sense of the meeting that, considering the time of the year, the demand for the various classes of pipe and tubes was up to a fair average. Those present thought that the fair demand which had existed for a year was a source of great satisfaction both to the manufacturers and workmen, who had received a steady run of business at reasonable rates throughout the season.

Locomotives.—The Pittsburg Locomotive Works, of Pittsburg, Pa., are finishing a contract for 25 engines for the Baltimore & Ohio.

The Brooks Locomotive Works, of Dunkirk, N. Y., are building 10 moguls and 5 switching engines for the Cleveland, Cincinnati, Chicago & St. Louis. Among recent engines shipped are four 18 x 24 ten-wheel passenger engines, weight 122,000 lbs., to the Chesapeake & Ohio, four 19 x 24 moguls and two 18 x 24 six-wheel yard engines to the Illinois Central, and five 18 x 24 moguls to the Flint & Pere Marquette. Also some passenger and ten-wheel freight engines for Cuba.

Interlocking.—The Johnson Railroad Signal Co., of Rahway, N. J., has the contract for interlocking apparatus at Millstone Junction, on the New York Division of the Pennsylvania Railroad.

Condensing System of Pumping Engines.—The condensing system designed by Mr. J. W. Hill, of Cincinnati, has already been referred to in these columns, and Mr. Hill has now issued an illustrated descriptive pamphlet. The system consists essentially of a plain surface condenser, arranged to take water from the suction or discharge pipe of the main pumps, which water, after it has effected the vacuum in the condenser, is returned to the pipe from which it is taken. With high-duty engines the temperature of the water is raised from 2 to 3°, and with low-duty engines from 4 to 6°. Pumping engines fitted with this system of condensation waste little water, as the water pumped is delivered into the force main, and is made available for consumption.

Street Cars.—The Laclede Car Co., of St. Louis, Mo., has orders for 40 grip cars and 40 passenger cars for the Denver City Cable Ry. Co., 20 grip cars and 10 open cars for the Kansas City Ry. Co., 20 closed cars for the St. Paul Cable Ry. Co., and 12 motor cars for the Redondo Ry. Co., of Los Angeles, Cal.

The Robinson & Moan Car Co., of Chicago, has an order on hand for electric cars for the Joliet Street Ry. Co., of Joliet, Ill.

The John Stephenson Co., of New York, which built the Julien storage battery cars now running on the 4th Ave. line is building electric cars for Cleveland, O.; Omaha, Neb.; West Superior, Wis.; West Dallas, Tex.; and Vancouver, B. C.

The Newburyport Car Co., of Newburyport, Mass., has orders on hand for a large number of street cars.

The Pullman Palace Car Co. is building at its Detroit works a large double truck car for the Fisher-Rae electric railway at Sault St. Marie, Mich.

Road Crossing Signals.—The Western Maryland Ry. is putting up a magneto-electric alarm signal at the principal grade crossings; the signal has a gong which is rung on the approach of a train. A lever, set at any desired distance from the crossing, is operated by the wheels of the train and sets the apparatus in motion; the gong continues ringing until the train has passed. The appliance is being put in by the Pennsylvania Steel Co., which owns the patents.

Electric Locomotive.—W. H. DARLING, of Brooklyn, N. Y., has had an engine built at the New York Locomotive Works, Rome, N. Y., and is now equipping it with his electric apparatus. The electricity is stored in what would be the fire box of an ordinary engine, and the reciprocating movement of the pistons is caused by currents in coils wound round the cylinder. The engine weighs 16 tons. This locomotive is built on the storage system, and now holds 250 cells of new storage battery, furnished by the Mutual Electric Manufacturing Co., of Brooklyn. MARTIN V. HAYNES at present has charge of the dynamo and batteries. The Darling Locomotive Co. has been organized with a capital stock of $60,000.

Track Drill.—The Smith friction drill for track work works by a cam action on friction rollers instead of by ratchet motion. The agents for the sale of this tool are Sherburne & Co., of Boston.

Palace Car.—Mr. C. L. ARNOLD, of Wilmington, N. C. has designed a new form of drawing-room boudoir car and sleeper. The main feature is the manner of arranging the berths. The seats have backs 33 ins. high, and have adjustable arms that can be thrown down when it is desired to make the berths. When the arms are thrown down, one seat is slipped over to the other, and the berth is made across the car, and not lengthwise, as in the Pullman or Wagner cars. No curtain is used, but the roof of the car, is made of adjustable panels which let down, forming staterooms with doors, that open and shut, on hinges. In each apartment there is a lower and an upper berth. The berths are made on one side of the car, and the gangway runs along the other side.

The National Water Purifying Co., of New York, reports contracts for filters as follows: Water-works filter plants at Terre Haute, Ind., (3,000,000 galls. capacity in 24 hours); Peace Dale, R. I.; Wakefield, R. I.; Rocky Brook R. I., and Narragansett Pier, R. I. Also mill filter plants for the Muncie Pulp Co., Muncie, Ind., (1,500,000 galls. capacity); the Michigan Carbon Works, Detroit, Mich.; and the Firmenich Mfg. Co., Marshalltown, Ia. The Terre Haute plant will comprise 12 high pressure filters, and will be the second largest filtering plant in the world, being next to that at Chattanooga, Tenn. The system of surface washing employed by the National Co. seems to have sent business their way, as they report orders booked amounting to about $175,000.

The Laidlaw & Dunn Co., of Cincinnati, O., has sold another 300 H. P. Galloway boiler to the Geo. H. Friend Paper Co., West Carrollton, O. This makes 3 of this size sold to this concern within a year.

Snow Ploughs.—The Juli Mfg. Co., of Brooklyn, N. Y., has sold its snow excavator already constructed and now stored at Rome, to the Union Pacific R. R. Co., for $15,000, delivered at Rome, N. Y., and the same company has given an order for a second machine to be constructed for use upon one of its narrow gauge lines.

BRIDGES AND CANALS.

New York State Canals.—Proposals for the following work will be received until Oct. 11, by JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y.: (No. 2) for improving 11,800 lin. ft. of the Champlain canal, between Stillwater and Bemis Heights: (No. 3) for improving 8,700 lin. ft. of Champlain canal south of Schuylerville. (No. 4) for improving 325 lin. ft. of Champlain canal, southward from lock No. 12. (No. 5) for improving 4,000 ft. of Champlain canal, from lock No. 14 southward. (No. 6) for improving 476 lin. ft. of Champlain canal, north of its junction with Glen Falls Feeder. (No. 7) for rebuilding one berme bridge abutment, and one bridge superstructure, and raising one tow path bridge abutment at bridge No. 115, about 3,600 ft. south of lock No. 16, Champlain canal. (No. 8) for building two bridge abutments and one bridge superstructure at bridge No. 13, first south of lock No. 7, Champlain canal; 7 bailing and draining; 5 grubbing, clearing and mucking; 1 maintaining highway during construction; 3 removing old bridge superstructure; 50,375 cu. yds. excavation of earth; 27,050 cu. yds. excavation of rock; 170 cu. yds. excavation of old abutment masonry; 2,051 cu. yds. embankment; 3,350 yds. lining; 380 cu. yds. procuring and puddling; 40 cu. yds. loose stone; 860 cu. yds. slope wall; 597 cu. yds. vertical wall in cement; 640 cu. yds. vertical wall laid dry; 375 cu. yds. abutment masonry (including coping); 38,200 ft. B. M. hemlock timber per M.; 4,100 ft. B. M. white oak timber per M.; 18,300 ft. B. M. white pine timber per M.; 10,200 lbs. wrought-iron; 7,100 lbs. cast-iron; 1,300 lbs. spikes and nails; 3 painting bridge superstructures. Deduct materials furnished by State: 70 cu. yds. abutment face stone (delivered ¾ of a mile south of lock 14) at $7; 25 cu. yds. abutment face stone in work at $8; 65 cu. yds. abutment backing stone at $2.50; 20 cu. yds. vertical wall stone at $1.75; 20 cu. yds. loose stone at 75 cts.

Chesapeake & Ohio Canal.—A press dispatch from Frederick, Md., says: "The discussion by the people of Williamsport of the subject of repairing the Chesapeake & Ohio canal from Cumberland to Williamsport, in order to open up canal traffic between those points once more, has set people along this section of the canal to thinking of the probability of forming a company to proceed with the repair of the canal to meet the work of repair at Williamsport, and thus open up the waterway for a greater distance. All sorts of mental calculations are being made as to the financial policy of such a plan, which it is hinted, if carried through, would instigate the Montgomery county people to look after the repair of the canal from Point of Rocks to Georgetown. In the meantime the railroad companies continue to take advantage of the shippers, who erstwhile had the canal to fall back upon when railroad rates did not suit."

Topeka, Kan.—The City Council has passed an ordinance calling an election for Nov. 5, 1889, to vote $250,000 in bonds to build a bridge across the Kansas river on Kansas Ave. The bridge is to be 72 ft. wide over all, with 53-ft. clear roadway and 8-ft. sidewalks. It will be a steel truss, to carry a live load of 120 lbs. on sidewalks, and 200 lbs. per sq. ft. on the roadway. It will be paved with red cedar blocks. There are to be 5 spans of 250 ft. each, on stone piers and abutments. Bids will not be called for until some convenient time after the election. LEWIS KINGMAN, is City Engineer. The total cost of the bridge will be $250,000.

Bridge Notes.—***Carratunk Falls, Me.***—The new railway bridge, being built by the Berlin Iron Bridge Co., of East Berlin, Conn., is nearly completed.

Greenbush, N. Y.—The Railroad Commissioners have decided that the New York Central & Hudson River and the Boston & Albany railways should construct an iron highway bridge across their track on Broadway. It is to have a 22 ft. roadway and 2 sidewalks 6 ft. wide; 20 ft. headway above the rails; grade of approaches not to exceed 7 per cent. The cost will be borne by the railway companies, and when the bridge is completed, that part of the street under it will be closed.

Allegheny, Pa.—The Smithfield St. bridge is being widened about 24 ft. to accommodate a cable railway.

Williamsport, Md.—This place and Berkeley, W. Va., are interested in a project for a bridge over the Potomac river.

Keyser, Md.—A bridge over the Potomac river between Hampshire and Allegany counties is projected. The County Commissioners will be petitioned to build it.

Washington, D. C.—The South Capitol St., Anacostia & Giesboro Road & Bridge Association has been organized by ANDREW K. BROWNE, ADAM SAUNDERS, ALEXANDER MOFFETT and others. It will build a bridge over the eastern branch of the Potomac, and roads connecting with it.

Louisville, Ky.—The lowest bidder on the construction of the masonry for the bridge across the proposed new channel of the east fork of Beargrass Creek, at Payne St., was C. L. Cornwall.

St. Louis, Mo.—The Merchants' Bridge Terminal Co. has awarded contracts as follows for the southern approach on Ferry St.: oak lumber, Methudy & Myer; yellow pine, J. P. Richardson; bolts and washers, Daniel Kerwin; framing, Taylor, Lutz & Moore; masonry, C. F. Brown.

Kansas City, Mo.—Mr. GEORGE KAHMAN, engineer of the new Winner bridge, and Mr. H. S. Hopkins, the contractor, have arrived on the ground, and work on the Clay county side will soon be commenced.

Glenwood Springs, Col.—State Engineer MAXWELL has located the site of the new bridge over Grand River, and proposals will be opened Oct. 1. There will be one span of 235 ft. and 1 of 125 ft., with 95 ft. of approaches. The appropriation is $45,000.

Denver, Col.—The contracts for the Larimer St. ridge were not let, as recently stated, although the acceptance of the bids was recommended. New bids will be received.

Viaducts.—***Chicago, Ill.***—A viaduct over the tracks at Ogden Ave. is projected, the cost to be paid by the railway companies and the city.

Kansas City, Kan.—Mayor COY has received a letter from the Missouri Pacific officials announcing that the company is disposed to construct the viaduct over its tracks at Central Ave. during the present season. The viaduct proper will be built by the railway company, while the city will construct the approaches. The structure will be 1,000 ft. in length, including approaches, and will involve an expenditure of about $35,000.

Omaha, Neb.—It has been decided that the 10th St viaduct shall be 80 ft. wide.

ELECTRICAL.

Electric Lighting.—***Leominster, Mass.***—The Leominster Electric Light & Power Co. has been awarded a contract for lighting the entire city. The capital stock will be increased and the plant enlarged.

Rockville, Conn.—The Rockville Gas Co. will put in an electric light plant on the Thomson-Houston system.

Charleston, W. Va.—The Charleston Electric Light, Power & Heat Co. has been authorized to erect poles and wires.

Georgetown, Ky.—Address the mayor for particulars of the proposed electric light plant.

Sumter, S. C.—The Sumter Electric Light Co. has a contract for lighting the city. The Waterhouse arc lights and Westinghouse incandescent lights will be used. A plant is being put in by the D. A. Tompkins Co., of Charlotte, N. C., at a cost of $14,000. Pseident, R. M. WALLACE; Secretary and Manager, D. J. AULD; Electrician, C. T. MASON, Jr.

Tampa, Fla.—The Tampa Electric Light & Power Co. has applied for a contract to light the city. If granted, the company will enlarge its plant.

Angola, Ind.—The city has decided to put in an electric light system.

Jeffersonville, Ind.—The Jeffersonville Electric Light Co. has been incorporated by E. J. HOWARD, JOHN ADAMS, and F. W. POINDEXTER. Capital stock, $25,000.

Pana, Ill.—The City Council has awarded a 20 years' franchise and a 5 years' contract to the Springside Coal Mining Co., for the right to erect and maintain an electric light plant, the lights to be incandescent lights of 25 c. p. The city agrees to pay $17 per year for each light, and starts out by taking 100 of them. The company has ordered a Thomson-Houston plant.

Chicago, Ill.—The Metropolitan Electric Light & Motor Co. has been organized by S. W. ADAMS, CHARLES S. RADDIN, and NATHAN WHITMAN. Capital stock, $500,000.

Wyandotte, Mich.—The Wyandotte Electric Light Co. has been incorporated, with a capital stock of $25,000.

Detroit, Mich.—The amended specifications call for proposals for 1, 2 and 3 years, with lights of 2,000 c. p. Six classes of bids are asked for: 1st, to furnish the city with all the necessary paraphernalia, towers, etc., for carrying on the lighting business itself; 2d, for furnishing the city a plant with all the necessary apparatus; 3d, for lighting the city with as advantageous an electric lighting system as the present one; 4th, the wires to be laid under ground within the one-mile circuit; 5th, bids for lighting the city with an overhead system; and 6th, lighting the city, the wires to be buried within the half-mile circuit.

Walla Walla, W. T.—The Walla Walla Electric Light & Gas Co. has been incorporated by THOMAS QUINN, A. R. BURFORD, and C. E. BURROWS. Capital stock, $100,000. An incandescent light plant will be put in.

San José, Cal.—The San José Light & Power Co. has been incorporated by CHARLES OTTO, H. H. KOOSER, and E. W. CLAYTON. Capital stock, $1,000,000.

Victoria, Tex.—The Victoria Light, Power & Ice Co. has been incorporated by T. M. O'CONNOR, G. H. LEIB, and J. M. BRONSON, and will put in an electric light plant.

SEWERAGE AND MUNICIPAL.

Sewers.—*Philadelphia, Pa.*—At a recent meeting of the council an ordinance was introduced authorizing the mayor to engage an expert sanitary engineer to examine the present system of sewerage, and to prepare, if necessary, a plan for its improvement.

Louisville, Ky.—M. J. Bannon has been awarded the contract to build part of the sewerage system, and J. R. Gleason, has the contract for a sewer on Walnut St.

Birmingham, Ala.—The contract for the Morris Ave. sewer has been awarded to Andrews & Connell, at $10,692.

Denver, Col.—A storm sewer from Broadway to Cherry creek is proposed.

Fort Worth, Tex.—The city engineer is preparing plans and specifications for the 18¼ miles remaining to complete the sewerage system.

Montreal, Can.—Dr. LABERGE, Medical Health Officer, stated recently that it would be his principal endeavor now to extend the drainage system all through the city, as the best, and in fact only, means to improve the health of the city. Out of 150 miles, of streets there were only 90 miles of drains, and it was imperative to build the 60 remaining miles as soon as possible, and do away altogether with privy pits throughout the city. He thought it might be a good thing to open the drains at both ends, to prevent an accumulation of sewer gas.

Pekin, Ill.—Over 2 miles of brick sidewalks will be laid this fall. Nine years ago Pekin had scarcely any sidewalks. It was then that permanent improvements commenced, and stone curbing and good brick sidewalks have been ordered down and built every year since.

Los Angeles, Cal.—Several propositions for the disposal of the sewage are being considered. Col. R. S. BAKER has offered to take it for use on his ranch if the city will build the necessary outlet sewers. The cost would be about $150,000. According to a San Francisco paper, the proposition to issue bonds for $1,280,000 for a sewer system was defeated because it was believed that the proposed outfall sewer would lead to serious litigation with the owners of land at Ballona, where the sewage was to be deposited in the ocean; and also it was considered that the water in the sewers was too valuable for irrigation purposes to allow it to be wasted, according to the proposed plan.

Grand Rapids, Mich.—The Board of Public Works has published its report for the year ending April 30, 1889. There were 23,442 lin. ft. of sewers built, 67 manholes and 48 catch basins. There are now 42.127 miles of sewers, and 148.462 miles of streets. The sewerage is as follows: 18.358 miles of brick, 26.276 miles of glazed pipe, 0.48 mile of cement, 1.853 mile of wood, 0.16 mile of iron pipe sewer in river.

Gas Works.—*Salt Lake City, Utah.*—The Salt Lake City Gas Co. has been granted additional privileges. The price is not to exceed $2.50 per 1,000 cu. ft. for the city, or $3 for private consumers.

Duquoin, Ill.—The Duquoin Gas Light Co. has been incorporated by GEO. W. WALL, P. N. POPE and J. M. BROWNING. Capital stock, $30,000.

Garbage Cremation.—The Detroit Sanitary Works, of Detroit, Mich., has taken a contract to dispose of the city's garbage for 3 years, and the machinery and plant are being put up.

WATER-WORKS.

NEW ENGLAND.

Bucksport, Me.—PARKER SPOFFORD, President of the Bucksport Water Co., informs us that the new works will be completed about Nov. 15. Estimated cost, $20-000. Contractor, James Mildull.

Milford, N. H.—The pumps for the new works have arrived, and will be placed in position as soon as the building is ready for them.

Northwood, N. H.—A survey is being made for the distance, and laying the water pipe, from Jenness pond to the Narrows.

Vergennes, Vt.—A small amount of extensions are being made.

Westfield, Mass.—Another special town meeting on the water bond subject will soon be held at Woodbury. Moulton & Stearns, of Springfield, who were the highest bidders for the $111,000 loan, think there is a technical flaw in the action of the recent meeting authorizing the issue of the bonds.

Holyoke, Mass.—The Water Commissioners are lowering about 1,000 ft. of pipe on Lincoln St.——By pushing the work on the Whitney St. dam until Nov. 1, the Water Commissioners expect to have about two-thirds of the work completed.

Lowell, Mass.—The question of erecting a filtering plant is being considered by the Water Board.

Provincetown, Mass.—A bill has passed the Legislature authorizing the town to construct works.

Hinsdale, Mass.—The new works will be completed about Nov. 1.

North Adams, Mass.—The reservoir through which the water from Broad Brook is to pass into the new main has been tested. The work of laying the large main is progressing rapidly, and the cut through the granite ledge at Braytonville is now being made.

Boston, Mass.—The Common Council is investigating different places as sources for an additional supply.

Windsor Locks, Conn.—The contractors have finished laying the street mains. They are now working on the dam and laying the supply pipes to the pump. The bottom of the 110-ft. stand-pipe has been finished and enclosed in cement at the foundation.

Litchfield, Conn.—The entire capital stock, $25,000, of the Litchfield Water Co. has been taken, and a meeting of the stockholders has been called for Oct. 8, to consider the advisability of increasing the stock. It is understood that work on the reservoir will be begun at once, and the company intend to deliver water in the village by June 1, 1890.

Warehouse Point, Conn.—The new works will be completed about Oct. 15. The reservoir will not be constructed until next spring.

MIDDLE.

Coxsackie, N. Y.—Works are projected. The Board of Trade has the matter in charge, and is examining plans and details.

Holley, N. Y.—A majority vote of 92 has been cast in favor of constructing works, and the following resolution has been passed by the Village Trustees:

Resolved: That the trustees of the village of Holley may and they are hereby authorized to make a contract for 5 years, with some water company for supplying the village with water for the purpose of extinguishing fire. That said Board of Trustees shall not be empowered to make contracts for more than 30 hydrants, nor pay more than $37.50 per hydrant per annum.

Rochester, N. Y.—A supplemental report on the water supply question has been presented to the Special Water Commission by Chief Engineer J. NELSON TUBBS.

Larchmont, N. Y.—The Larchmont Water-Works Co. has purchased the Hickory Grove mill-dam property, and is to convert it into a reservoir for the storage and supply of water for the village.

Carthage, N. Y.—The town has voted $50,000 with which to construct works.

Jordan, N. Y.—The trustees have authorized the borrowing of $20,000 for improving the company's plant. THOMAS F. GOODRICH and SANSOM PEROT have been elected members of the Board.

Clyde, N. Y.—Mains have been laid across the river, and the south side is now supplied with water.

Albany, N. Y.—The committee appointed by the citizens of the Southwest End to confer with the Water Commissioners on the subject of a more plentiful supply report that the commissioners are to put about 60 men at work immediately, laying a large main from the Powder Hill Reservoir.

Hamburg, N. Y.—The town has voted to contract with the Hamburg Water & Electric Light Co. for a 20 years' water supply, for fire protection, for $1,000 per year. A well, 50 ft. in diameter by 20 ft. deep, has been dug, and 5 miles of mains are now being laid. A stand-pipe, 125 ft. high, is now being erected. The works will be completed in about 60 days. Estimated cost, $35,000.

Lyons, N. Y.—A system of charcoal filters is being put in at the pumping-station.

Jersey City, N. J.—The question of an increased and purer water supply is again being discussed by the City Council.

Newark, N. J.—The contract with the East Jersey Water Co. was formally signed Sept. 26. The company has a paid-up capital of $3,000,0.0. [The terms of the contract, and names of officers, etc., were given in our issue of Aug. 10.—ED.]

Annville, Pa.—"The Humelle Water Co., of Lebanon County," has been chartered at Harrisburg, to construct works. The capital stock is $15,000. The directors are: W. S. SEABOLD, S. L. BRIGHTBELL, HENRY KILLINGER, RUDOLPH HERR, M. F. BATDORF, JOHN L. TAYLOR, Dr. E. B. MARSHALL, Dr. J. W. FRABERT, J. S. KENDIG, SAMUEL COTTRELL and HARRY ZIMMERMAN.

Pittsburg, Pa.—It is reported that the city is about to spend $2,000,000 for new works.

SOUTHERN.

Hendersonville, N. C.—The town will employ an engineer, and begin the construction of a gravity system of works at once. Estimated cost, $30,000. Address W. L. HYMAN, Mayor.

Rutherford, N. C.—Mr. SIDDONS, of Richmond, Va., has recently held a conference with the Town Commissioners on the subject of constructing works. The contract was not closed, but it is probable that a system of works, costing between $2,000 and $2,500, will soon be established.

Goldsboro, N. C.—It is expected that the new works will be completed by Jan. 1, 1890. The pipe has been received, and trenching will be begun soon.

Charleston, S. C.—Three artesian wells now furnish a daily supply of 1,750,000 galls. Their average depth is about 2,000 ft. The last one sunk, just completed, flows about 800 galls. per minute.

Savannah, Ga.—A flow of 1,500 galls. per minute is being obtained from the new artesian well at a depth of 525 ft.

Macon, Ga.—GEORGE F. PAYNE has recently made an analysis of the water, and pronounced it of a superior quality.

Bessemer, Ala.—The Bessemer Land & Improvement Co. will charter a separate corporation to operate their water-works.

Eufaula, Ala.—The company is about to increase its supply by sinking several wells near its present source of supply.

Meridian, Miss.—Prof. J. W. MULLET has made an analysis of the water taken from the artesian wells recently bored, and pronounces the water to be well adapted for domestic use. As a result of this test the company have accepted the work of the contractors who bored the wells, and the City Council at a special meeting have accepted the water for the city's use. The 4 wells have a guaranteed capacity of 800,000 galls. per day.

NORTH CENTRAL.

Cincinnati, O.—HENRY BAER, Jr., is reported as recently stating that the problem of laying a pipe from Lake Erie, along the bed of the Miami canal from Toledo, as a new source of supply, is now being studied.

Columbus, O.—Bids will be received until Oct. 15 for constructing an engine-house, boiler-house, and smoke-stack at the Alum creek pumping station. Address A. H. MCALPINE, Superintendent and Engineer.

Cambridge, O.—The acceptance of the proposition made by Hinds & Bond, to establish works on the rental system, has been defeated by a majority vote of 200.

Portsmouth, O.—The City Council is considering the advisability of selling its works. A proposition to purchase them has been made by H. Q. ADAMS.

Paris, Ind.—A serious shortage in the supply is reported.

Huntington, Ind.—Bids will be received for constructing works until Nov. 1. Address JOSEPH M. BLACK, City Clerk.

Terre Haute, Ind.—The company has closed a contract with the National Water Purifying Co. for a filtering plant, to be ready for operation Feb. 1, 1890. Two new buildings are to be constructed, one for new pumps, the other for filters; bids will soon be wanted. New and larger mains are to be laid, and the system generally improved and extended. Estimated cost, $200,000.

Teuton, Mich.—It is reported that the town has voted $25,000 for improvements.

Nashville, Mich.—Works costing $20,000 are to be constructed. Address the City Clerk.

Ithaca, Mich.—Works are projected.

Jacksonville, Ill.—The contractors have sunk 1,900 ft. of casing in the well being sunk for the city's supply.

Dallas City, Ill.—Works are projected.

Carrollton, Ill.—Sealed proposals will be received on Oct. 15 for boring an artesian well. Said well to be 8 ins. in diameter for the first 150 ft. and 6 ins. for the remainder. Bidders are required to state the price per foot for the first 1,000 ft., and the price per foot for each 100 ft. additional up to 2,000 ft., the city reserving the right to terminate the contract at any time after the completion of the first 1,000 ft. in case a flow is secured. Address L. S ELDRED, Mayor, or ED. MINER, City Clerk.

Chicago, Ill.—An ordinance has been offered in the City Council to give a 30 years' franchise to a private corporation granting the right to establish a high-pressure water system in the territory between Chicago Ave. and Sixteenth St., and Halstead and the lake—the entire business district. The city to have the right to attach its fire hydrants to the company's mains and use the water for fire protection.

Austin, Ill.—A small number of street mains has been ordered laid.

Burlington, Wis.—It is reported that works are to be constructed. Address the City Clerk.

NORTHWESTERN.

Missouri Valley, Ia.—The contract for complete works has been awarded to the Fremont Foundry & Machine Co., of Fremont, Neb., at $14,785. A 500,000-gall. pumping engine will raise water from wells to a reservoir of 200,000-galls. capacity. The works are to be in operation by July 11, 1890.

Rock Rapids, Ia.—Works are to be completed about Nov. 1. E. E. Fuzzell & Co., of Larned, Kan., have been awarded the contract.

Winona, Minn.—The Canton Wrought-Iron Bridge Co. has been awarded the contract for furnishing roofs for the new buildings, at $3,625.

Mankato, Minn.—A special election is soon to be held to vote on the question of issuing $40,000 of bonds, for improving and extending the works.

Lakeside, Minn.—It is reported that the Lakeside Light & Water Co. will take immediate steps to get materials for complete works on the ground. The officers are: D. C. CASH, President; W. E. PERRY, Secretary and Treasurer; WALTER VAN BRUNT, Superintendent.

Two Harbors, Minn.—Work is progressing rapidly.

Argentine, Kan.—Nearly all street mains have been laid. Workmen are now at work on the pump-house.

Marysville, Kan.—A system of works is being constructed.

Atkinson, Neb.—Works are to be constructed at once. An unanimous vote in favor of issuing $7,000 of bonds has been taken.

Hooper, Neb.—The town has issued $5,400 of bonds with which to construct works.

Geneva, Neb.—The town has voted in favor of works, and steps will soon be taken to construct them.

Beatrice, Neb.—The City Council has appropriated $500 to make a test of the well and spring system as a source for the city's supply.

Helena, Mont.—It is again reported that the four companies have consolidated and will hereafter be known as the Consolidated Water Co. Capital stock, $1,000,000.

SOUTHWESTERN.

St. Louis, Mo.—The Board of Public Improvements has opened bids for the construction of the new inlet tower for the water-works extension plant at Chain of Rocks as follows:

Anderson & Barr, $107,400; Allen & Vieths, $109,285; Anderson & Bro., $126,907. All bids were rejected, the Committee considering them too high.

Butler, Mo.—The contract for complete works has been awarded to Col. S. H. Dewey, of Jefferson City, Mo.

Bryan, Tex.—A. B. CARR has sent us the following:

The successful bidders for constructing works were as follows: J. N. Cole, J. N. Henderson, Geo. G. Gorrell, Geo. W. Smith, W. P. Bunnough, W. D. McConnico, and L. S. Fuller. Contract prices, $18,000.

Dallas, Tex.—The Cook Well Co., of St. Louis, Mo., is about to begin sinking wells as a new source of supply.

Corpus Christi, Tex.—The well, for the city's supply, has reached a depth of 1,380 ft. If water is not found at a depth of 2,000 ft. the well will be abandoned.

Eddy, Col.—A system of works is to be constructed in this newly settled town. The supply will be brought from springs, 1½ miles distant.

Sopris, Col.—The Denver Fuel Co. is improving its works at this place. A large reservoir is being dug on the north side of the river, opposite the pump house.

Denver, Colo.—Bids will be received at the office of the Citizens' Water Co. until Oct. 1, 1889, for the construction of a tunnel 1,600 ft. long, located on the Boulevard north of Bear Creek, on Sheridan Heights. Address RICHARD HOLME, Manager.

Salida, Col.—The city has sold $20,000 of bonds, at a premium of $813, to Cleveland, O., parties.

Santa Fé, N. M.—A meeting of the Artesian Well Co. has recently been held. The reorganization of the company was effected, and the following officers elected: SOL. SPIEGELBERG, President; C. F. A. FISCHER, Vice-President; C. M. CREAMER, Treasurer. F. W. CLANCY was authorized to continue his correspondence looking to securing a first-class man to take a contract for sinking a test well.

PACIFIC.

Port Townsend, Wash.—The Mount Olympus Water Co. has filed articles of incorporation with the auditor under the franchise granted by the City Council on Jan. 18. The incorporators are: H. E. MORGAN, HENRY LANDES, A. W. BASH, THOMAS JACKMAN, NATHAN D. HILL, WILLIAM PAYNE, A. H. BAINBRIDGE, CHARLES EISENBEIS, F. A. KUHN, L. B. HASTINGS, R. C. HILL, and R. E. ANDREWS, the first five named being trustees. HENRY LANDES, President; N. D. HILL, Secretary; R. C. HILL, Treasurer; R. E. ANDREWS, Engineer. The company propose to replace the city's present inadequate supply with a system with capacity sufficient for the fire protection and other uses for a city of 75,000 inhabitants. The source of supply will be from a point on the Little Quilcene River, near the Clallam County line, about 20 miles from the city. The water at this point flows from the springs of Mount Constance. The elevation is 900 ft. above tide-water. A reservoir of about 10,000,000 galls. capacity, and capable of delivering from 3,000,000 to 4,000,000 galls. daily, will be constructed on Morgan Hill at elevation of 300 ft. above tide-water. There will also be a storage reservoir in Eisenbeis' addition.

Seattle, Wash.—An ordinance has been introduced in the City Council, granting JOHN S. MAGGS, his heirs, executors and assigns, the right to lay water pipes in certain streets of the city, and defining the conditions upon which such right is granted.

Whatcom, Wash.—The new works will be put in operation about Dec. 1.

Sumner, Wash.—The Farmers' Water Co. has recently been incorporated. Capital stock, $12,000. The incorporators are: W. E. DANIEL, WILLIAM N. SPINNING, WILLIAM HAMMON, and EDWARD COLE. The object of the company is to construct and maintain a system of works to supply the people along the line of the Puyallup Valley.

McMinnville, Ore.—Work will soon be begun. Part of the machinery has been received.

Los Angeles, Cal.—Several additional hydrants have been located by the City Council.

Stockton, Cal.—Steps are being taken to secure a better water supply for fire protection. Address the Mayor.

San Francisco, Cal.—A. W. VON SCHMIDT has substituted a proposition from the Lake Tahoe & San Francisco Water-Works Co., offering to supply the city with 30,000,000 galls. of water daily for $15,000,000. The company further proposes, upon the completion and fulfilment of the contract, to turn the works over to the city and county, guaranteeing to it forever the right to receive from the lake daily the amount of water agreed to be furnished. The payment of the total sum is suggested to be made in bonds, $1,000,000 for the first year, increasing a million each year until paid. The communication was referred to the Committee on Water and Water Supply.—A proposition has also been made by William J. Wilsey, to supply 75,000,000 galls. of water daily from the American River, for $1,200,000.

Santa Cruz, Cal.—In the proposed new works the water is to be brought from Laguna Creek, a distance of 10 miles. The system will include a reservoir of a capacity of 60,000,000 galls., 13 miles of distributing pipe and 200 hydrants, and is to be completed within one year. The pipe specifications call for 52,175 ft. of 14-in. wrought iron pipe; 30,000 ft. of this No. 9, and 22,175 No. 11 iron, from Laguna Creek head works to the Santa Cruz reservoir; 11,000 ft. of 14-in. pipe, No. 9 iron, to city. The city pipe system will have 4,000 ft. 12-in., 15,000 ft. 8-in., and 40,000 ft. 6 x 4 in. cast-iron pipe.

Moscow, Idaho.—Bids will be received until Oct. 28 for $25,000 of bonds, authorized by an election held Sept. 9 for the construction of works. Address J. W. LIEUALLEN, Clerk.

Ogden, Utah.—An application for a charter to establish works has been made by Judge PATTON and others.—The City Engineer's report on the location of fire hydrants has been adopted by the Water Committee.

CANADA.

West Toronto Junction, Ont.—A system of works has been established. Improvements are contemplated.

London, Ont.—Superintendent TRACY'S report to the City Council in favor of filling up a portion of east pond, and nearly the whole of upper west ponds, and put in a tile drain, has been adopted. It is proposed to largely increase the supply by developing neighboring springs.—He has also submitted the following estimate of the cost of material needed for increasing the supply: Six-in. pipe, 12,000 ft. $9,600; 4-in. pipe, 16,000 ft. $8,000; hydrants ($40), $1,600; valves, etc., $800; total, $20,000, exclusive of cost of extra water or pumping machinery.

ARTESIAN WELLS.

Edgerton, Dak.—A well is to be sunk for irrigating purposes.

Elberton, Ga.—A dug well, 80 ft. deep, recently caved in, killing one of the workmen.

Bamberg, S. C.—Jenning & Bamberg have been awarded a contract for sinking a well.

Batesburg, S. C.—A well will probably be sunk. Address T. BLACK.

Fort McPherson.—J. W. JACOBS, Captain and A. Q. M., U. S. A., will receive bids for sinking a well at Fort McPherson until Oct. 14.

Laredo, Tex.—A well is to be sunk.

Newark, Cal.—A well on Wilson's ranch has been finished. It is 408 ft. deep by 8 ins. in diameter. The water rises ¾ ins. above the pipe, and discharges 62,000 galls. in 24 hours.

Birmingham, Ala.—The Louisville & Nashville Railroad Co. are sinking a well at their machine shops.

Meridian, Miss.—Improvements will probably soon be made to the city's well. Address the City Clerk.

Cordele, Ga.—The well has reached a depth of 450 ft.

Meade Center, Kan.—Two successful wells have been sunk by the American Investment Co., of Topeka, Kan.

Nevada.—Premiums for artesian wells are offered by the State, the amount depending upon the depth and flow of the wells.

IRRIGATION.

Ogalalla, Neb.—The County Commissioners have signed a contract with S. L. Wiley, of Omaha, for the completion of the irrigation and water-power canal. Work will be commenced at once, and be pushed to completion as rapidly as possible.—Sealed proposals will be received for $35,000 of Ogalalla canal bonds on Oct. 4, by FRANK DICKERSON, County Clerk.

El Paso, Tex.—It is proposed to retain the flow of water for six months by building a large dam. The lake would be 15 miles long, 3 miles wide, and 25 ft. deep, and would cover 36,000 acres of ground.

New Mexico.—A canal to irrigate the Rio Puerco Valley is to be built at once. It will be about 30 ft. wide and 3 ft. deep, and will run on both sides of the river for 250 miles. There will be a number of dams and reservoirs placed along the canal, one of which will hold about 500,000,000 cu. ft. of water.

Austin, Tex.—The Presidio Irrigation Co. has been incorporated by J. J. ACOSTA, S. L. ACOSTA, J. M. BARRELLO, and N. SANCHEZ, to construct canals on the Texas side of the Rio Grand river.

North Yakima, Wash.—J. D. MCINTYRE, Chief Engineer of the North Yakima Irrigating Co., has returned to Helena, Mont., and will return in about 10 days and begin operations at once on his scheme, which includes irrigation back to the foothills on both sides of the Yakima river, with canals several miles above the highest ones now constructed.

Osceola, Nev.—Two hundred men are at work on the water ditch.

Ogden, Utah.—The articles of incorporation of the Bear Lake & River Water-Works & Irrigation Co. have recently been filed. It names the following gentlemen as directors: JAS. C. ARMSTRONG, L. B. ADAMS, Z. B. RICHARDS, JAS. H. BACON, JOHN T. CAINE, Dr. F. E. ROCHE and JOHN R. BOTHWELL. The capital stock of the company is placed at $2,100,000.—M. GARLAND, contractor, informs us that the following contracts for work on the Bear Lake & River Irrigation & Water-works Co.'s canal were awarded on Sept. 15. Also that they will soon be ready to let other contracts. J. A. Larson & Co., Helena, Mont., excavating 50,000 cu. yds. solid rock; and 550 lin. ft. tunnel; F. J. Campbell, Buena Vista, Col., 1,000 lin. ft., tunneling, and 100,000 cu. yds. of solid rock; Goldsmith & Co., Kansas City, Mo., 150,000 cu. yds. earth work; John Carroll, Watertown, Dak., 150,000 cu. yds. solid rock and 350,000 cu. yds. of earth; Walter Mathison, Kansas City, 200,000 cu. yds. earth; Jones Bros., Sioux Falls, Dak., 100,000 cu. yds. solid rock, and 450 lin. ft. of tunnel; Gardner & Crause, Sioux City, Ia., 150,000 cu. yds. earth.

Phœnix, Ariz.—DONALD W. CAMPBELL, of Denver, is now engaged in making surveys and estimates for a large canal to be constructed in this vicinity. It is to have a carrying capacity of 1,250 cu. ft. per second, and will reclaim about 100,000 acres of land. It will be supplied from the Gila river.

Carson, Mo.—An examination of sites for storage reservoirs along the east branch of the Carson river has recently been made by Col. BRIDGES, Governor STEVENSON, Surveyor-General JONES and RICHARD RYLAND. Col. BRIDGES estimates that a complete system of reservoirs can be constructed in the foothills along the river at a cost not to exceed $100,000, which would hold sufficient water to irrigate all the land suitable for agricultural purposes in Douglas and Ormsby counties.

Washington, D. C.—Maj. J. W. POWELL, Chief Engineer of the Geological Survey, has returned after 55 days' constant work as a member of the Senatorial Committee investigating irrigation in the West. North and South Dakota, Montana, Washington, Oregon, Idaho, Utah, Nevada, California, Arizona, New Mexico, Texas, Indian Territory, Kansas, Colorado, Wyoming and Nebraska were visited, 80 meetings were held, and over 200 witnesses heard. The arid land that can be irrigated and made productive will include the larger portion of each State visited; in all about 100,000,000 acres.

Santa Fé, N. M.—Work on the Pecos Valley Irrigation Co.'s canal is progressing rapidly, 20 miles having been completed. Several large reservoirs have been completed, one of which is 7½ miles long and 2 miles wide.

Pueblo, Col.—The survey of the State ditch, to be taken out of the Arkansas River, about a mile from the Royal Gorge, is now being finished in the Grand Cañon.

Antonito, N. M.—The Taos Valley Co. will soon commence the extension of its canal into New Mexico. The reported estimated cost of the work is $100,000. They will give employment to several hundred men and teams.

La Junta, Col.—The projectors of the Bent County canal have sent W. N. HANDALL over the upper end of the surveyed line, with instruction to find a suitable head-gate lower down.

Dakota.—Citizens of Fargo, Bismarck, and Grand Forks have a scheme to build a canal from the Missouri River at Bismarck to Lake Traverse and Big Stone Lake, the object being to obtain an easy watercourse to Minneapolis and the Gulf of Mexico. The scheme would also promote the projected irrigation work in this vicinity.

Kootenay Lake, B. C.—Tenders are wanted by C. W. BUSK for excavating land and removing boulders, and doing other work to aid in reclaiming land in this vicinity. The work is being done under orders of the Kootenay Valley Co., of London.

ANNUAL REPORTS.

Receipts of the following water-works reports are hereby acknowledged:

Connecticut.—Bridgeport; Bridgeport Hydraulic Co, GEO. RICHARDSON, Superintendent.

Florida.—Jacksonville; R. N. ELLIS, Superintendent.

Michigan.—Grand Rapids; H. A. COLLAR, City Engineer.

Pennsylvania.—Philadelphia; JNO. L. OGDEN, Chief of Bureau of Water. An extended notice of this report will be given elsewhere in these columns in a future issue.—Westchester; CHAS. B. LEAR, Chairman Water Committee.—Girardville; Report of the Board of Directors of City Trusts, containing report on Girard Water Co., E. C. WAGNER, Assistant Superintendent.